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VOL. CXXXIII.—No. 3463] LONDON: FRIDAY EVENING, MAY 12, 1922 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

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Germany's Naval Airships and their War Record.

Chinese Engineering Notes.

Imperial Wireless Communication.

Recent Developments in Power Station Design.—No. XXIX.

Steam Turbine Reliability.—No. II.

New Sewage Pumps at Richmond.

The White Star Liner Majestic.

The Iron and Steel Institute.

A Large Sleeper Creosoting Plant.

The Institution of Chemical Engineers.

PUBLIC NOTICES

Civil Service Commission.

PORTHCOMING EXAMINATION: INSPECTORS IN THE ENGINEER-IN-CHIEF'S DEPARTMENT of the GENERAL POST OFFICE (17-22), 9th JUNE.

The date specified is the latest on which applications can be received. They must be made on forms to be obtained, with particulars, from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1. 8145

The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of :—

(1) GAS ENGINE, Horizontal, Single-cylinder, and GENERATOR.
(2) SCALES and MACHINES, WEIGHING.
(3) MACHINES, LITHOGRAPHIC, Rotary.
(4) TIN SHEETS.
(5) SPRINGS, HELICAL and VOLUTE, for Engines, &c.

Forms of Tender may be obtained from the Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than Two o'clock p.m. on Friday, the 2nd June, 1922, for Nos. 1 to 4, and on Tuesday, the 30th May, 1922, for No. 5.

T. RYAN,
Director-General.
8174

SALE BY TENDER.

G. R.

BOARD OF TRADE.
BY ORDER OF CONTROLLER, TIMBER DISPOSAL DEPARTMENT.

AERIAL ROPEWAY,
KINGSLAND STATION, HEREFORD.

To be Sold by Private Tender, the AERIAL ROPEWAY at KINGSLAND STATION, as and where standing.

TOTAL LENGTH ABOUT 3¼ MILES.

Trestles or standards, 83 in number, from 10ft. to 50ft. in height, built of angle iron in sections of 6ft. lengths by 2ft. 6in. square. The ropeway is worked by a 12 H.P. PORTABLE ENGINE, which may be included in the offer or left out.

All the spare sections or parts of the ropeway lying at Kingsland unloading station or at the loading station are included.

Offers for above ropeway, with or without engine, will be received by ACTING CONTROLLER, 49, Wellington-street, London, W.C. 2, up to and including May 25th, 1922.

The highest or any offer will not necessarily be accepted. 8106

IN THE MATTER OF W. H. DORMAN AND COMPANY LIMITED AND REDUCED
and
IN THE MATTER OF THE COMPANIES (CONSOLIDATION) ACT 1908.

Notice is Hereby Given that the order of the High Court of Justice Chancery Division dated the 4th day of April 1922 confirming the reduction of the capital of the above named company from £700,000 to £437,500 and the minute approved by the Court showing with respect to the capital of the company as altered the several particulars required by the above statutes was registered by the Registrar of Companies on the 26th day of April 1922.

Dated the 5th day of May 1922.

CAPORN and CAMPBELL,
St. Bride's House,
Salisbury-square, E.C. 4,
8135 Solicitors for the Company.

City of Nottingham.
NORTH WILFORD POWER STATION.
(FOUNDATION—CONTRACT NO. 1.)

CONTRACTORS wishing to TENDER for HEAVY FOUNDATION WORK at the above are requested to apply by letter to Mr. T. Wallis Gordon, Acting City Engineer, Guildhall, Nottingham.

Only those firms having the necessary plant and experience should apply.

W. J. BOARD,
Town Clerk.

Guildhall, Nottingham,
3rd May, 1922. 8129

Royal Burgh of Kirkcaldy.
ELECTRICITY WORKS, VICTORIA-ROAD.

The Provost, Magistrates and Council invite TENDERS for the following WORK :—

SPECIFICATION NO. 1.—STEAM TURBINE, THREE-PHASE ALTERNATOR, CONDENSING PLANT and PIPING.

A copy of the specification and accompanying drawings can be seen at and obtained from the offices of Messrs. Kennedy and Donkin, 17, Victoria-street, Westminster, S.W. 1, on and after Saturday May 13th, upon payment of a deposit of £2 2s. An additional copy of the specification can be obtained upon payment of a deposit of £1 1s. These deposits will be returned after the receipt of a bona fide Tender and on the return of the specification and drawings.

Tenders, on the prescribed form, enclosed in sealed envelopes and addressed on the outside "Electricity Supply, Tender to Specification No. 1," must be delivered at the office of the undersigned not later than 10 a.m. on Monday, 5th June.

W. L. MACINDOE, Esq.
Town Clerk's Office, Kirkcaldy,
May, 1922. 8138

The Great Indian Peninsula RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely :—

No.		Fee for Specification.
1.	ROOF WORK (for Goods Shed).....	£1
2.	CANVASES, &c.	10s.

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Roof Work" or as the case may be, not later than Eleven o'clock a.m. on Tuesday, the 23rd May, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.

Company's Offices,
48, Cornhill-avenue, E.C. 3,
London, 10th May, 1922. 8164

PUBLIC NOTICES

Corporation of Durban, Natal.

The Corporation of Durban, Natal, is prepared to receive TENDERS (from British firms only) for the SUPPLY and DELIVERY "Free on Board" of 400 TONS of GASWORK COAL TAR or TAR SUBSTITUTE for roadmaking purposes. No water gas tar, coke oven tar, or blast-furnace tar will be accepted.

Conditions and specifications may be obtained from the undersigned, to whom the Tenders, in duplicate, sealed and endorsed, must be sent in to arrive not later than Monday, June 5th, 1922.

The Corporation does not bind itself to accept the lowest or any Tender.

By Order,
WEBSTER, STEEL and CO.,
5, East India-avenue, London, E.C. 3,
8173 Agents to the Durban Corporation.

Ventnor Urban District Council.
REPAIRS TO TIE RODS, &c., TO THE ROYAL VICTORIA PIER AND LANDING STAGE.

The Ventnor Urban District Council invite TENDERS for the REPAIR and REPLACEMENT of a number of TIE RODS and other IRONWORK to the understructure of the Royal Victoria Pier and Landing Stage, Ventnor.

Plans, sections and specification may be seen at the office of Mr. D. V. Howard, the Engineer and Surveyor to the Council, Town Hall, Ventnor, I.W.

Tenders, sealed and endorsed "Pier Repairs," to be delivered to the undersigned not later than Noon on the 7th day of June, 1922.

The Council do not bind themselves to accept the lowest or any Tender.

(Signed) JAMES WEAVING,
Clerk to the Council.

Town Hall, Ventnor, I.W.,
May 10th, 1922. 8149

NOTICE.

Colombo Municipality, Ceylon.

REQUIRED by the Municipal Council, Colombo, Ceylon, an ASSISTANT DRAINAGE ENGINEER.

Candidates must have passed the examination of the Associate Members of the Institution of Civil Engineers and have had a good experience of modern sewerage, sewage disposal and house connection work. They should not exceed 30 years of age and preferably be unmarried.

Appointment, on probation, three years, on a salary of Rs. 9000 per annum, with travelling allowance of Rs. 900 per annum; thereafter permanent, pensionable appointment on incremental basis guaranteed for efficient probationary service, with suitable leave.

Free first-class passage to Colombo and half-pay on voyage.

Application forms and full details can be obtained from the Council's London Agents, Messrs. John Pook and Co., 68, Fenchurch-street, London, to whom candidates should apply before May 31st, 1922.

E. R. JOSEPH,
Secretary,
Municipal Council, Colombo.
The Town Hall, Colombo,
March, 1922. 8062

Oxford County and City Mental HOSPITAL.
LITTLEMORE, NEAR OXFORD.

APPLICATIONS are INVITED for the POST of ENGINEER and CLERK of the WORKS at the above Hospital. Applicants must be able to supervise the working of a Gas Plant, Hot Water Installation for Central Heating, &c., Telephone System, and the General Building Repairs of the Hospital.

Applications, in candidates' own handwriting, stating salary required (in addition to house, coal, and light, which is provided), age and full particulars of experience, and accompanied by copies of three testimonials, to be sent to the MEDICAL SUPERINTENDENT not later than May 25th, 1922, endorsed "Engineer." 8172

PUBLIC NOTICES

Corporation of Calcutta.
APPOINTMENT OF EXECUTIVE ENGINEER, WATERWORKS.

1. APPLICATIONS are INVITED for the POST of EXECUTIVE ENGINEER, Waterworks, Calcutta.

2. The salary of the appointment, inclusive of all allowances (except motor car allowance of Rs. 100) is Rs. 1000 to 1500, according to qualifications and experience. The post is for a period of five years.

3. The person appointed will be required to keep a motor car, for the upkeep of which the Corporation will pay him an allowance of Rs. 100 per month. The cost of a motor car will, if desired, be advanced by the Corporation and recovered in monthly instalments spread over 2 years, on the motor car being mortgaged to the Corporation.

4. The appointment is subject to the Provident Fund, leave, and other service rules of the Corporation and may be terminated at any time by six months' notice on either side. The Provident Fund contribution is 8¼ per cent. of the monthly salary and an equivalent amount is contributed by the Corporation and the fund accumulates at compound interest.

5. The selected candidate will be required to devote his whole time to the duties of his office and will not be allowed to take up any outside work. He must reside in Calcutta. He will be liable to removal during the term of his office for misconduct or neglect of or incapacity for his duties. He will be required to submit to a medical examination before joining his appointment.

6. The Corporation will pay his passage (1st class) from London to Calcutta, but he must refund the amount so paid if he gives notice any time within two years from the date of taking up his appointment.

7. He will be required to take up his appointment about the 1st October, 1922, and will receive half-pay for the period occupied by the journey.

8. Preference will be given to candidates who are members or associate members of the Institution of Civil Engineers or Graduates in Engineering of a University, and have had waterworks experience, especially in regard to pumping machinery and modern methods of waste prevention.

9. Candidates are to state their age, qualifications, and experience.

10. Applications will be received in England up to Monday, the 12th June, 1922, by W. C. Easton, Esq., B.Sc., M.I.C.E., 149, West George-street, Glasgow, from whom any other information concerning the conditions of service may be obtained; or in Calcutta up to Monday, the 12th June, 1922, by the Chief Engineer to the Corporation of Calcutta.

D. V. RAMIAH,
Secretary to the Corporation.
Central Municipal Office, Calcutta,
The 13th April, 1922. 8074

SITUATIONS OPEN

ACTIVE DIRECTOR REQUIRED in Established London Engineering Company with excellent connections and showing substantial profits. Full-time occupation. Investment £5000. Salary and share of profits. Audited accounts open to accountants' and solicitors' investigations.—Write, Box DD3, N.A.S., St. Ann's Chambers, Ludgate-hill, E.C. 4. 8160 A

EXPERIENCED RELIABLE MECHANICAL ENGINEER REQUIRED, age between 30/40, having extensive knowledge of Internal Combustion Locomotives. Must be fluent speaker and writer of the French language. Must possess initiative, be thoroughly energetic, tactful in dealing with men, and of proved commercial ability, to act as Agent in France for British Engineering Firm. Gentleman having undeniable qualification and references will please send qualifications and experience, training and salary required to 8148, The Engineer Office. 8148 A

REPRESENTATIVES REQUIRED in all Principal towns in the U.K. for the Sale of Solders, &c., on commission basis.—Address, 8171, The Engineer Office. 8171 A

PUBLIC NOTICES

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
PLATEN PRINTING PRESSES.

The Proprietors of British Patent No. 14,886 of 1911 are PREPARED to SELL the PATENT or to LICENSE British Manufacturers to work under it. It relates to a pneumatic paper feeding device in which the printing stroke of the platen is automatically stopped if a sheet of paper has not been fed into the printing position.

Address, B. W. & T.,
111/113, Hatton-garden,
8144 London, E.C. 1.

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
STEAM SUPERHEATERS.

The Proprietor of British Letters Patents No. 119,999 and No. 158,022 is PREPARED to SELL the PATENT or to LICENSE British Manufacturers to work thereunder. They relate to superheaters constructed to rid steam of its water by impact. The impact surfaces comprise a series of blades circumferentially arranged in a cylinder, to which steam is passed through tangentially arranged nozzles.

Address, B. W. & T.,
111 and 112, Hatton-garden,
8142 London, E.C. 1.

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

Notice is Hereby Given that KOHLER COMPANY, of Kohler, Sheboygan County, State of Wisconsin, United States of America, SEEK LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 147,643, granted to them for "Improvements in or relating to Electric Generating Systems."

Particulars of the proposed amendment were set forth in the Illustrated Official Journal (Patents) issued on the 3rd May, 1922.

ANY person or persons may give notice of opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.

W. TEMPLE FRANKS,
8123 Comptroller-General.

SITUATIONS OPEN (continued)

FIRM of TIMBER MERCHANTS and SAW MILLERS in Punjab, India, invite APPLICATIONS for POSITION of MANAGER from gentlemen thoroughly efficient in organisation and management.

Applicants should give full particulars of experience, stating age and salary expected, and be able to produce satisfactory testimonials as to character and ability.

Address, 8083, The Engineer Office. 8083 A

WANTED, STRUCTURAL DRAUGHTSMAN for Consulting Engineer's Office. Used to London work and detailing. State salary expected.—Address, P5386, The Engineer Office. P5386 A

DESIGNER of REINFORCED CONCRETE CONSTRUCTIONS, with thorough knowledge of Calculations of all types of Buildings, Bridges, and Jetty Constructions, WANTED by Firm of Contractors and Engineers, Westminster.—Address application, stating previous experience and salary expected, 8147, The Engineer Office. 8147 A

DRAUGHTSMAN, Leading, Having Good Experience Band Conveyors, Light Steel Structures, preferably Wood also. Must be competent make all calculations, give quick, accurate, reliable work; get good output from drawing-office and co-operate enthusiastically. Full particulars training, experience, salary required.—Address, 8162, The Engineer Office. 8162 A

MECHANICAL DRAUGHTSMAN.
EASTBOURNE WATERWORKS COMPANY.
This APPOINTMENT has now been MADE; regret unable to reply to applicants individually.
J. C. BOWLEY,
8134 A Engineer.

MACHINE TOOL DRAUGHTSMAN WANTED, experienced in the Design of Capstan and Turret Lathes.—Apply by letter, giving full particulars of qualifications and wages required, to Messrs. H. W. WARD and CO., Ltd., Dale-road, Selly Oak, Birmingham. 8151 A

WANTED, FOUNDRY FOREMAN, Thoroughly experienced in High-class Light Engine Castings. Must have special knowledge of gun-metal mixtures for heavy pressures and all Admiralty test requirements. About 60 hands employed. None but thoroughly reliable experienced men with good references need apply. Good position for suitable man.—State age, wages, and full particulars to A. G. MUMFORD, Ltd., Colver-street Engineering Works, Colchester. 8141 A

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ENGINEER (35) DESIRES BERTH, Home or abroad. Experienced in layout of new plant, economical to operate; of labour, fire-clay draughtsman. Sound testimonials.—Address, P5369, The Engineer Office. P5369 B

ENGINEER, G.I. Mech. E. (24), 4 Yrs. Tech., 4 Yrs. shop, 3 yrs. D.O., SEEKS SITUATION. No agencies.—28, Ashdown-road, Kingston-on-Thames. P5379 B

ENGINEER, Experienced in Sewerage, River Improvements and hydro-electric work, is OPEN to an ENGAGEMENT at home or abroad.—Address, P5696, The Engineer Office. P5393 B

ENGINEER, Thoroughly Practical, Combined with theory in steam, oil, gas, milling machinery, office routine, draughtsmanship, &c., late engineer to well-known companies, excellent testimonials, DESIRES APPOINTMENT abroad or home.—Address, P5340, The Engineer Office. P5340 B

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ENGINEER (27), Mechanical, M.C., B.Sc. (Hons.), good general engineering education, works experience, DESIRES START on commercial or production side. Will start without pay for necessary experience.—Address, P5304, The Engineer Office. P5304 B

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FERRO-CONCRETE.—SPECIALIST ENGINEER, with wide and varied experience in handling design and construction (bridges, buildings, silos, harbour works, &c.), is OPEN for APPOINTMENT, England or abroad.—Address, P5326, The Engineer Office. P5326 B

GENTLEMAN, with Full Business and Engineering qualifications and experience, DESIRES to REPRESENT in (or TAKE CHARGE of) LONDON OFFICE for Manufacturing Firm, where industry and concentration, coupled with a detailed knowledge of all aspects of buying, costing, manufacture, sales, and publicity, will bring results mutually satisfactory.—Address, P5367, The Engineer Office. P5367 B

MECHANICAL ENGINEER, with Good Practical and general experience as foreman, cost clerk, and manager, NEEDS responsible POST in any capacity, any district.—SNOAD, 36, York-road, Hitchin. P5395 B

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THOROUGHLY Practical ENGINEER SEEKS APPOINTMENT (home); at present abroad. Wide experience with erection and maintenance of Diesel and semi-Diesel crude oil engines, auction gas plants, dredging and mining machinery, locomotives, steam cranes, engineering workshops, &c. Excellent testimonials.—Address, P5280, The Engineer Office. P5280 B

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DRAUGHTSMAN (ASSIST.), 21, 5 Years' Workshops and D.O. experience; good ref., I.C.S. student; salary £3.—Address, P5388, The Engineer Office. P5388 B

DRAUGHTSMAN SEEKS BUSINESS or POSITION. Intelligent working drawings and tracings or technical and trade journals, catalogues, exhibitions, &c.; qualifications by indentures and exam.; varied experience, pre-war standing.—Address, P5378, The Engineer Office. P5378 B

JUNIOR DRAUGHTSMAN (23) REQUIRES POST; 3 years' drawing-office experience, 3 years' theoretical training, well up in detail work, steel floors, tanks, boilers, stills, pressure vessels, &c.; able to supervise erection; excellent references.—W. Redtoft, "Parkinsley, Beckenham, Kent. P5390 B

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FOREMAN BOILERMAKER, Disengaged, Non-union man, SEEKS POSITION as Foreman on Locomotive or Stationary Boilers or General Work; 15 years' experience as head foreman, home and abroad; total abstainer; good references.—Address, P5392, The Engineer Office. P5392 B

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YOUNG ENGINEER, Fitter-Turner (21½), SEEKS POSITION ABROAD; exper. petrol engines, machine tools, dynamos; 3 months' exper. native labour; big, strong, take anything.—Address, P5373, The Engineer Office. P5373 B

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FOR HIRE, PUMPS and WELL-BORING TOOLS for Contractors' Deep Wells, &c., 2in. to 24in. dia.—E. RICHARDS and CO., Upper Ground-street, London, S.E. Telephone No. 978 Hop. 822 G

FOR SALE or HIRE, ELECTRIC MOTORS from 60 to 300 H.P.; PORTABLE STEAM ENGINES from 8 to 40 N.H.P.; STEAM BOILERS, CRANES, PUMPS, MACHINE TOOLS of every description; reasonable terms, immediate delivery.—J. T. WILLIAMS and SONS, 97, Queen Victoria-street, London, E.C. Tel., City 3010. K.

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AUSTRALIA—Alfred Herbert (Australasia), Ltd.: Sydney.
JAPAN—Yokohama, Tokio, Osaka.
CANADA—Toronto. 8131 D

ENGINEER, A.M.I.M.E., M.I.A.E., &c., with London office, is OPEN to REPRESENT MANUFACTURERS or act as English Agent for continental firms engaged in engineering and allied trades or specialities. Inquiries invited.—Write, WILLIAM A. COPSEY, 4, Devonshire-chambers, 146, Bishopsgate, London, E.C. 2. P5276 D

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WANTED, to ARTICLE a YOUTH, aged 17, to a Firm of Engineers. Premium if required.—Address, P5374, The Engineer Office. P5374 H

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TUITION BY POST.—Inst. C.E. and I. Mech. E. Enrol now for next Exams.; 100 per cent. passes last examination. Reinforced Concrete, new comprehensive course under expert engineer, £2 2s. Write for particulars.—PENNINGTONS, University Tutors, 254, Oxford-road, Manchester. Estab. 1876. Ex.

PATENTS

THE PROPRIETOR of BRITISH PATENT No. 7660/15, dated May 11, 1915, relating to "Steering Mechanism for Automobiles and the like," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Ill. 8091 H

THE PROPRIETOR of PATENT No. 129,058, for "Improvements in and relating to Scotch Marine Boilers," DESIRES to DISPOSE of the said PATENT RIGHTS or of NEGOTIATING for the GRANT of LICENCES to work thereunder.—Communications should be addressed to F. W. GOLBY, Patent Agent, late of His Majesty's Patent Office, 2, John-street, Bedford-row, London, W.C.1. 8092 H

THE PROPRIETORS of PATENT No. 120,835, for "Improvements in and relating to Apparatus for Heating Cartridges and the like," are DESIROUS of DISPOSING of the PATENT RIGHTS or of NEGOTIATING for the GRANT of LICENCES to work thereunder.—Communications should be addressed to F. W. GOLBY, Patent Agent, late of His Majesty's Patent Office, 2, John-street, Bedford-row, London, W.C.1. 8093 H

THE PROPRIETORS of LETTERS PATENT No. 124,514, relating to "Electric Starter for Internal Combustion Engines," DESIRE to DISPOSE of their PATENT or to grant LICENCES to interested parties on reasonable terms with a view to the adequate working of the patent in this country.—Inquiries to be addressed to CRUIKSHANK and FAIRWEATHER, 65-66, Chancery-lane, London, W.C. 2. 8142 H

THE PROPRIETOR of BRITISH PATENT No. 17,121/12, dated July 23, 1912, pertaining to "Improvements in and relating to Metal Tube Forming Machines," DESIRES to ENTER INTO ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Ill. 8163 H

THE PROPRIETORS of the Following BRITISH PATENTS are DESIROUS of NEGOTIATING with interested parties for the SALE thereof or for the granting of LICENCES on reasonable terms for the purpose of EXPLOITING same and ensuring the full development and working in this country, viz.:—Nos. 14,866/14, "Breech Closure for Firearms"; 129,028, "Lubricating Ammunition in Guns"; 130,678, "Breech Mechanism of Firearms"; 130,998, "Gas Cartridges Lubricators"; 148,022, "Breech Mechanism for Firearms"; 149,028, "Small Arms and Machine Guns"; 148,100, "Small Arms or Machine Guns"; 149,451, "Firearms"; 149,452, "Lubricating and/or Ejecting Mechanism for Firearms"; 141,533, "Cartridge Magazines for Guns"; 148,024, "Cartridge Magazines for Guns"; 148,593, "Small Arms"; 149,097, "Breech Mechanism of Small Arms and Machine Guns"; 134,799, "Lubricating Projectiles"; 141,596, "Ammunition Lubrication"; 140,080, "Small Arms"; 151,192, "Cartridge Lubricating Devices"; 150,216, "Gun Barrels"; 152,907, "Gun Sights"; 153,526, "Portable Signal Devices"; 150,238, "Breech-closing Mechanism for Small Arms or Machine Guns"; 160,000, "Cordeless Ammunition Cartridges"; 160,000, "Breech Locking Mechanism of Machine Guns"; 162,853, "Buffers"; 161,506, "Lubricating Ammunition of Small Arms and Machine Guns"; 161,510, "Gun Lubrication"; 162,962, "Small Arms and Machine Guns"; 160,723, "Lubricating the Bores of Guns Using Fixed Ammunition"; 161,125, "Small Arms"; 161,126, "Firing Mechanism for Guns"; 161,128, "Magazines for Firearms"; 166,851, "Small Arms and Machine Guns"; 166,569, "Small Arms"; 168,979, "Breech Closure for Small Arms"; and 169,901, "Breech Closure for Guns."

Inquiries should be addressed to WM. BROOKES and SON, 52/56, Chancery-lane, London, W.C. 2. 8197 H

COMPANY MEETING

Bell's United Asbestos Co., LIMITED.

A SATISFACTORY REPORT.

The Annual Meeting of this Company was held at the Cannon Street Hotel yesterday at 2 o'clock.

Mr. J. Alfred Fisher, the Chairman of the Company, presided.

The Auditors' report having been read, the Chairman first referred to the death of Mr. T. B. Lightfoot, and then said:—

"The report we are now asking you to consider and adopt, in so far as it relates to the results of our business in the year ending 31st December last, will, we think, strike you, as it certainly does your Directors, as a satisfactory one, having regard to the state of chaos in trade and finance which has prevailed, and is still raging like a pall, with rare exceptions, over British industries. The most sanguine amongst us could hardly have expected that the brilliant results achieved in a year of boom would be repeated in a year which will be remembered as one of the darkest in commercial history. Therefore I think you will agree that this Company may be congratulated upon the exceptionally sound financial position again revealed by the accounts. It is certainly gratifying under the circumstances that we are able to recommend the payment of a dividend of 10 per cent. for the year on a capital double that of three years ago, to place to reserve a sum equal to a further 2½ per cent., to carry forward a very substantial balance, and to have reserves, all told, amounting to 84 per cent. on the paid-up ordinary shares, and cash and liquid assets amounting to £438,702 in excess of current trade liabilities.

"Nevertheless you may consider that in some respects the Report is of a less reassuring character than usual. Well, we conceive it to be your desire that we should show you, as far as we can, both sides of the picture, and we must face the situation as it is to-day.

"The outstanding fact is that trade, instead of improving, continued to decline, and although there may here and there be a rift in the clouds, the general outlook remains gloomy. When our public men, like the President of the Board of Trade, say that 'None of us have seen a condition of things approaching that of to-day,' and when old-established business men of far greater marshlands than ours are practically in the melting-pot, it would be almost a miracle if this Company were able to pass unscathed through the crisis."

After alluding to the low prices now prevailing and the necessity of reducing expenses, the Chairman said:

So far as labour is concerned, there have been indications in the past year of a growing disposition to recognise the difficulties with which manufacturers are faced. What is wanted now more than ever before is, that this recognition of difficulties should be transformed as quickly as possible into more active co-operation in overcoming them. Wages costs, which went up by leaps and bounds during the war, are being reduced in relation to the fall in the cost of living, and the reductions, so far as our own workers are concerned, are being accepted with reasonable appreciation of their necessity. But it cannot too often be brought home to every person employed, not merely in the factory, but in every department of every business concern, that there should be continuous and conscientious endeavour to earn what they receive. There is no room to-day for slackers, and it is certainly to be hoped that the hard incontrovertible facts will be more generally appreciated both in the workroom and office that costs of production and distribution must be brought down if we are successfully to emerge from the present trade crisis.

"There is also great need for drastic reductions in local expenditure and taxation where the burden falls with exceptional severity on large employers of labour. In our own case, not only have the local rates been more than trebled, but assessments have also been greatly increased.

POLITE.

"I am pleased to say that the favourable reputation of 'Polite' is fully maintained, and that it is now regarded as practically indispensable in the building trades. We have introduced a new tile for roofing purposes, giving an entirely new finish and effect of a really artistic nature hitherto lacking in asbestos-cement tiles—a drawback which has been criticised by many architects. These tiles are known as 'Bell's Pantiles,' and as the new colour effect is applicable to other 'Polite' materials, their undoubted quality and proved durability should ensure for them, with a revival of building operations, a constant and increasing demand.

"The use of 'Polite' for bungalows and other residences would be greatly facilitated if local by-laws were more uniform, for while in some localities such structures are encouraged, in others there are certain restrictions which we cannot but think are somewhat unreasonable, particularly as the Ministry of Health have expressed unqualified approval of 'Polite' houses, which are admitted to be substantial, utilitarian and artistic, and I may also add, can be insured against fire at the same rates as houses built of brick or stone.

NEED FOR CO-OPERATION.

"The need for economy in costs of production and expenses of distribution, as affecting traders generally, has lately been much commented on in the Press and elsewhere, and it is noteworthy that influential opinion has made important advances in the direction of advocating and even urging some form of consolidation of the interests and resources of competing firms in the same trade.

"It has been said that it is characteristic of British industry that it tends to be individualistic and competitive. When this is carried to such an extent as to be wasteful and to cause a squandering of resources, it cannot be beneficial either to the manufacturer or, in the long run, to the consumer, for when the weakest producers are through intense competition been driven to the wall, the consumer will assuredly have to pay more dearly for what he buys. This is especially true in reference to the internal trade of the country.

"The question applies with even greater force to our overseas trade. Formerly Great Britain was the undisputed manufacturing country and competition practically counted to our own shores. This was the 'nation of shopkeepers,' and trade rivalry was healthy, because, although costly and even wasteful, it stimulated invention and improvement. Now it is different. We have as a nation to compete with a progressive 'world of shopkeepers,' and in order to preserve our national position in the world's markets it becomes more desirable, if not necessary, where circumstances are favourable, to pursue a policy of internal co-operation, to economise and to secure greater efficiency of service in many ways which united effort alone renders possible.

"We have felt it to be our duty to you as Shareholders to discuss these matters in a frank and friendly spirit with competitors, and although the proposals so far made have not proved mutually acceptable, they know that we are ready to welcome further discussion and to consider any amendment likely to operate beneficially for all concerned—producers and consumers alike."

MAINTENANCE OF QUALITY.

"Meanwhile this Company will not under any circumstances have recourse to methods of cheapening, at the expense of quality, any goods sold under its Trade Marks. We shall continue to do our utmost, even to the extent of drawing liberally on our Reserves, if necessary, to uphold our position in the asbestos trade, and to maintain those standards of quality which have so materially contributed to our success, for 'Bell's Asbestos' are household words that for many years have been known to mean a brand of excellence which must not be allowed to lose their valuable significance, and I hope that what I have said will meet with your approval and support."

RAYBESTOS.

The Chairman alluded to his visit to the United States last year in connection with the prohibitive tariffs proposed to be imposed on imports of asbestos goods, and the threatened interference with as important contracts held by the Company for the supply of asbestos yarns to the Raybestos Co., of Bridgeport, Conn., for use in the manufacture of their brake and clutch linings for motor and other vehicles. These goods, which are sold under the name of "Raybestos," have a worldwide reputation, and are similar to articles manufactured and sold by this Company under the trade name "Asbestos."

He said: "During my visit to the States pressure was brought to bear on the authorities, and some reductions in the proposed tariffs were made, but these were insufficient to admit of our contract being fulfilled without serious loss. Therefore, other means of protecting our joint interests were discussed, and a satisfactory arrangement has now been concluded. This provides for the cancellation of the existing contract and the amalgamation of the Raybestos Company's interests in Raybestos products, and this Company's interests in Belmoy products, in all territories other than the Continent of America.

"To give effect to the arrangement a new Company called 'Raybestos-Belmoy, Limited,' has been registered. Half the working capital will be provided by the Raybestos Company and half by ourselves, and the business will be conducted in London by a joint board.

"The Raybestos and Belmoy products will be manufactured at this Company's factory at Harefield for which purpose the Raybestos Company is supplying part of a special equipment free of cost. In part reimbursement of capital outlays incurred by us in the erection of buildings, they have also agreed to issue and surrender, without payment to us, £20,000 of debentures in this Company subscribed for by them in cash about two years ago. Upon the whole you will probably agree that this is a satisfactory settlement, and one which it is fair to state has been facilitated by the honourable and straightforward dealing of our friends on the other side of the Atlantic. Moreover, it is believed that we have secured a permanent and increasingly valuable, instead of a transitory, addition to our business."

After referring to some items in the Balance Sheet and expressing appreciation of the services of the Staff, the usual formal resolutions confirming the payment of a balance dividend of 7½ per cent. (making 10 per cent. for the year) and re-electing retiring Directors and Auditors, the meeting terminated.

8176

COMPANY MEETING

Bell's United Asbestos Co., Limited (continued).

MISCELLANEOUS

A CONSULTING ELECTRICAL and MECHANICAL ENGINEER would arrange to give WHOLE TIME to a large Group of Collieries or big Industrial Concern. Experienced in initiating and carrying out large schemes.—Address, P5385, The Engineer Office. P5385

ENGINEER has an Exceptionally Artistic DESIGN for ROAD BRIDGE, span 120ft., 15ft. clear; detailed designs and estimates in preparation; inquiries solicited.—Address, P5341, The Engineer Office. P5341 I

TRANSLATIONS (French, German, and Dutch) Accurate and prompt service.—H. SWIFT, 50 St. Bees-street, Moss Side, Manchester. Many years' experience in engineering trade. P5001 I

FOR SALE

A TIME RECORDER, as New, Guaranteed. Latest model. What offers?—A. V. PELLET, 149, Farringdon-road, E.C. 1. Ex.

A IR RECEIVER, New, Mild Steel, 10ft. by 4ft. dia., for 250 lb. working pressure; complete with all fittings; low price.—Address, 8128, The Engineer Office. 8128 G

BOILERS.—Davey P. "Economic" 15ft. dia. by 9ft., £450, steam 140 lb.; Lancs., 27ft. by 7ft., 100 lb., steam, £300; Dilido, 12ft.; two with superheater, all mech. stokers.

HYDRAULIC THREE-THROW PUMPS.—1 set, 24in.; other, 9in. rams, helical gear. Belt drive: £50 and £70 respectively.

HYDO'S, 36in. and 38in., 220 volts D.C., £42 and £50.

LOCO. &c., BOILERS, ENGINES (various).
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CROSSLEY Single-cylinder 120 H.P. GAS ENGINE for FOR DISPOSAL. Offers invited. Type A.G.E., speed 162 revs., magneto ignition. In first-class order, and may be seen working by appointment.—JOHN and EDWIN WRIGHT, Limited, Universe Rope Works, Birmingham. P5382 G

DIESEL ENGINES, Six-cylinder, Two and Four-stroke, 850, 1000, 1200 H.P. Excellent condition. DYNAMOS for above, 250 or 500 volts D.C. Immediate delivery and low price.

TWO 500 K.W. PARSONS TURBINE SETS, 250 or 500 volts D.C., with Condensing Plant and Spare Armature. Price £2200.

ELECTRICAL-DRIVEN CENTRIFUGAL, RAM, and other PUMPS, from 1½in.-10in. outlet.

JENNINGS, West Wallis, Newcastle-on-Tyne. Ex.

ENGINE FOR SALE.—350 H.P. Tandem Compound Condensing STEAM ENGINE, by Pollit and Wigzell, Sowerby Bridge, fitted with Corliss, H.P. cylinder, slide valve, L.P. by condenser, 15in. by 30in. stroke, 80 revs. per min. In good order and is being displaced by electric power. Also TWO WEIR PUMPS. Above can be seen by appointment.—SUN FLOUR MILLS COMPANY, Bromley-by-Bow, London, E. 3. 8146 G

EXCEPTIONAL OFFER, FOR PROMPT SALE.—1 1000 K.W., 500-Volt D.C. GAS ENGINE PLANT, including PRODUCER and AMMONIA RECOVERY PLANT. One of the most completely self-contained power gas installations in the U.K. In first-class condition.—Specification, drawings, photographs, and full details with efficiency data, &c., from BRITISH CENTRAL ELECTRICAL CO., Ltd., 6 and 8, Rosebery-avenue, E.C. 1. 'Phone, Holborn 5345. 'Grams, "Britlicel, London." 8161 G

FOR IMMEDIATE DISPOSAL at Bargain Price, owing to bulk power being installed, the following modern up-to-date PLANT, comprising:—
1500 K.W. British Westinghouse Mixed Pressure, 440-volt, 50-period, 3-phase TURBO-ALTERNATOR, supplied new 1916, with Rotarex Electrically Driven JET CONDENSING PLANT.

THREE 30ft. by 8ft. 6in. LANCASHIRE BOILERS, complete with all fittings, including Superheaters and Vickers Intes type Mechanical Stokers, insured 160 lb.

Also Generating Sets, Boilers, Economisers, Pumps, Gas Engines, Gas Producers, Cooling Sprinklers, Plate Steel Chimneys, Feed, Electrical and Control Plant.

Full particulars on application to SHIP CANAL PORTLAND CEMENT MANUFACTURERS, Limited, Ellesmere Port, Cheshire. 8088 G

FOR SALE, Brand New "Priestman" CRANE GRAB DREDGER, for mounting on barge or pontoon; 10-ton type crane, jib about 36ft., Capacity of grab 45 cubic feet. Packed ready for shipment. Bargain price to clear.—R. H. NEAL and CO., Plant Engineers, 83, The Broadway, Ealing, London, W. 5. 8010 G

FOR SALE, First Quality SECOND-HAND SLEEPERS; main line, uncreosoted; good for sidings, cart roads, &c.—R. H. NEAL and CO., 83, The Broadway, Ealing, W. 5. Telephone, Ealing 1794. 7831 G

FOR SALE, ONE Bellis Patent Quick-revolution TRIPLE-EXPANSION ENGINE, 800 B.H.P., with a steam pressure of 180 lb. to 190 lb. per sq. inch, 250 to 400 r.p.m. Full specification on application.—Address, 8159, The Engineer Office. 8159 G

FOR SALE, ONE Complete "Atlas" ICE-MAKING PLANT, with Engine, Air Compressor, Tanks, Travelling Crane, Piping, Condensers, and Pumps. Also ONE Babcock and Wilcox BOILER, 120 lb. working pressure. To be seen in London.—Full particulars on application to RICHARD SIZER, Ltd., Engineers, Wilmington, Hull. P5337 G

For continuation of For Sale Advertisements, see page iv.

Germany's Naval Airships and their War Record.

THE development of the German naval airship service and its work during the war form the subject of an interesting paper by Lieutenant von Schiller in the current number of the *Marine Rundschau*, the German semi-official naval monthly. According to this writer, the dirigible airship as a naval auxiliary was in a very early stage of evolution when the war broke out. It was only after a prolonged study of the performances of Zeppelins in private and army ownership that the Navy Department decided to order its first airship of this type. Completed in 1913, this vessel, designated the L 1, made a few successful flights, but was lost in September of that year in a North Sea gale. A second ship, the L 2, was equally unfortunate, being totally destroyed by a gas explosion on one of her first ascents. Dimensions and other particulars of these two first naval airships are given in the subjoined table. On the outbreak of war, therefore, the German Navy had only one airship, the L 3, under its control, and as she was detailed to the North Sea station, an old Parseval dirigible was temporarily employed for reconnaissance in the Baltic. The command of the naval airship section (Marine-Luftschiffabteilung) was vested in Captain Peter Strasser, who held this appointment till August, 1918, when he perished in an airship that was shot down in flames by British warships. It seems to be established that he was an officer of outstanding ability, whose technical knowledge, energy, and powers of organisation were largely responsible for the efficient state of the service throughout the war. Shortly after the outbreak of hostilities an agreement was reached with the Army command, under which one out of every two new ships completed by the Zeppelin Company was to be relinquished to the navy, which also secured control over a number of Schütte-Lanz airships. Measures were at once taken to increase the housing facilities. The first large shed, that at Nordholz, near Cuxhaven, had been hurriedly completed in August, 1914, and new sheds were ordered to be built at Tondern, in Schleswig, Haage, in East Friesland, and Seddin, in Pomerania, each of these stations being protected by an adjacent battery of anti-aircraft guns and searchlights. At the same time a chain of meteorological stations was established along the German coastline, from Ostend, Belgium, to Königsberg, in East Prussia. From these stations weather reports were transmitted every three hours by wireless or cable to the headquarters at Wilhelmshaven. Special arrangements had to be made for supplying gas to the various airship depôts, as in most cases the local resources were inadequate for the purpose. This widespread organisation absorbed a very large *personnel*, and it was no easy matter to find the requisite number of specially trained officers and men. Among the various aerial projects conceived during the war was one of sending up from Flanders an ordinary balloon, which was to drift over London and drop a 2200 lb. bomb on the city. This scheme was abandoned after three fruitless attempts had been made.

It was speedily discovered, states Lieutenant von Schiller, that the type of airship in vogue at the beginning of the war, which was of 22,500 cubic metres capacity, was not sufficiently powerful to perform the arduous duties of war, including long-distance raids. The next type was therefore increased to 32,000 cubic metres, which had already been reached in the first Schütte-Lanz to be acquired by the navy. Even this size proved inadequate, however, and early in 1916 the L 30, of 55,000 cubic metres, was built. The difficulty of handling such large vessels on the ground, especially in bad weather, was very great, for which reason it looked as though the limit in dimensions had been reached, and for the next two years the 55,000 cubic metre type continued to represent the standard German airship. Besides the Zeppelin, the only other rigid type that proved equal to the strain of war service was the Schütte-Lanz, and even vessels of that type were unsuited to North Sea work owing to their wooden construction. A few non-rigids were built for coast patrol, and a new type, built on the Gross-Basenach system, was evolved, but its performance is not described.

In the autumn of 1916 the naval airship service began to suffer severe losses in the course of its raids on England, where the anti-aircraft batteries and defending aeroplanes had become both numerous and efficient. One of the first vessels to be shot down was the L 31—in October, 1916—whose commander, Mathy, had carried out the first attack on the City of London twelve months previously. In spite of these losses, however, Captain Strasser worked unremittingly to overcome the defence, introducing various modifications which enabled the Zeppelins to rise to much greater altitudes when over enemy territory. By the summer of 1917, attacks were being made from heights so great that the *personnel* had to be artificially supplied with oxygen. Airships scouting at sea were also compelled to fly very high—eventually at 16,400ft.—in order to avoid attack by enemy seaplanes, and, later on, by aeroplanes flown from the decks of British cruisers.

At the end of 1917 a plan was evolved of conveying to the hard-pressed troops in East Africa a supply of ammunition and medicines by a Zeppelin, the feasibility of the enterprise having been demonstrated by an endurance flight of 105 hours made by the LZ 120. An airship of the 55,000 cubic metre class, L 57, was selected for the voyage and lengthened by 98½ft. to increase her useful load. This vessel, however, came to grief on her trial trip, and eight weeks elapsed before a new ship, the L 59, could be made ready. Starting from an emergency base at Jamboli, in Bulgaria, she had got as far as the Dachel oasis on the Upper Nile when a wireless message was received from Berlin, ordering her to return, as news had come of the evacuation of East Africa by the German troops. She returned to Jamboli without mishap, after a round voyage lasting ninety-six hours, the total distance covered being 4375 miles. This was unquestionably the boldest and most remarkable airship flight of the whole war, and one, moreover, that has not as yet been surpassed. On returning to her base, the L 59 was partially reconstructed, after which she made a raid on Naples. Her next exploit was to have been a bomb attack on the British naval base at Malta, but while *en route* in the Strait of Otranto she was destroyed in mid-air by an explosion, the cause of which was never ascertained.

In addition to casualties from enemy action, heavy losses were suffered through bad weather and accident. There had already been several cases of individual ships having been destroyed in their sheds by fire, but in January, 1918, five of the very latest vessels were simultaneously destroyed by an explosion at the Ahlhorn depôt. By 1918 it was recognised that the war value of the Zeppelin had sensibly declined. Aeroplanes, in conjunction with "an excellently organised artillery," had rendered airship raids on England too hazardous to be attempted, except on rare occasions when the weather was particularly auspicious. At the same time airship reconnaissance over the North Sea had become exceedingly dangerous by reason of the speedy and fast-climbing aeroplanes carried on British warships. These machines not only brought down a number of scouting Zeppelins, but even attacked the latter in their own sheds, two being destroyed in this way at Tondern in July, 1918. In the vain hope of circumventing British gunners and aviators, Captain Strasser designed a new type, beginning with L 70, which was fitted with seven motors and had a maximum ceiling of 23,000ft. On August 6th, 1918, this giant craft set out to raid England, those on board including Captain Strasser himself, who had insisted on making the expedition in spite of the remonstrances of his brother officers. While over the North Sea in bright moonlight the L 70 was sighted by British warships and promptly shot down in flames with the loss of all hands, the atmospheric conditions having been such that she could not maintain her maximum altitude. The death of Captain Strasser made a profound impression in Germany, which was intensified when, five days later, the L 53, commanded by Captain Probst, another of the ablest officers in the service, was destroyed in the North Sea, this time by an aeroplane. These successive disasters appear to have caused a reaction against the Zeppelin, for all further raids and reconnaissances were forbidden, pending the completion of a new type, which it was hoped would prove less vulnerable. This vessel had a capacity of 62,000 cubic metres, but before she was ready the German cause collapsed, and airship development was forthwith arrested.

The principal war duties assigned to the German naval airships were, according to Lieutenant von Schiller, as follows :—

(1) Daylight reconnaissance of a general nature in the Baltic, North Sea, Skagerrack, and Cattegat, and often as far as the British coast; in the summer months, night scouting.

(2) Scouting in advance when sorties by the fleet or special naval enterprises were contemplated.

(3) Screening the battle fleet at sea and giving escort to incoming or outgoing auxiliary cruisers.

(4) Protecting the mine-sweeping flotillas and occasionally searching for mines themselves.

(5) Making attacks against England and Russia.

In reviewing the Zeppelin raids on England, Lieutenant von Schiller argues that they were justified not only by the material and moral damage inflicted on the enemy, but also by the fact that the Zeppelin menace compelled England to retain at home a large number of guns, aeroplanes, and men whose weight would otherwise have been felt on the Western front. When the revolution occurred the German Navy had only seven effective airships left, and these were intentionally destroyed in their sheds in July 19th, 1919, the day on which the High Sea Fleet was scuttled in Scapa Flow.

It is evident from Lieutenant von Schiller's narrative that the building up and maintenance of Germany's airship fleet, with its sheds, gas depôts, weather bureaus, &c., must have imposed a heavy strain on her resources in money, man-power, and material, besides diverting a great deal of energy from other branches of war activity. This being so, one is constrained to ask whether the war services of the Zeppelin fleet bore any reasonable proportion to its cost. To this question no answer save an emphatic negative can be returned. So far as we are aware, German airships took no important part in any major naval operation of the war. Indeed, they were always absent at critical moments, *e.g.*, at the Dogger Bank and at Jutland, when efficient aerial scouting would have been of inestimable value to the High Sea Fleet. Although freely employed on patrol duty in the Heligoland Bight, they were never able to prevent our ships—especially the minelayers and submarines—from penetrating into those waters, even if they detected their approach. As instruments of offence they were a complete failure, the results—whether material, moral or both—of their raids over this

Particulars of the German Naval Airship Fleet.

Zeppelins.

Designation.	Capacity.	Useful load.	Motors.	Speed.	Ballonets.	Date of completion	Maximum ceiling.
	Cub. metres.	Kilos.	No. and H.P.	Ft. per sec.			Feet.
L 1	22,500	8,600	3 of 160	69	18	1912	—
L 2	27,000	11,000	3 of 160	68.9	18	1913	—
L 3 to 8	22,500	8,700	3 of 180	70	18	1914–15	8,200
L 9	25,000	10,000	3 of 210	72.2	15	1915	9,842
L 10 to 19	32,000	15,600	4 of 210	82	16	1915	10,500
L 20 to 25	35,800	17,800	4 of 240	82	18	1915–16	11,480
L 30 to 42	55,000	30,000	6 of 240	91.9	19	1916	13,123
L 43 to 52	55,800	39,000	5 of 260	96.5	18	1917	18,044
L 53 to 65	56,000	40,000	5 of 260	100	14	1917–18	19,684 to 21,324
L 57, L 59	68,500	52,000	5 of 260	91.9	16	1917	22,470
L 70	62,200	47,000	7 of 260	105	15	1918	21,980
L 71, L 72	62,200	49,000	6 of 260	105	15	1918	22,960
Schütte-Lanz.							
SL 3, 4	32,400	13,400	4 of 210	78.7	15	1914–15	8,857
SL 6, 8, 9	35,000	16,000	4 of 210	85.3	16	1915–16	11,480
SL 12, 14	38,700	20,000	4 of 240	85.3	17	1916–17	12,138
SL 20, 22	56,000	35,500	5 of 260	95.15	16	1917–18	14,763

NOTE.—In addition, there were four Parseval airships and one of a special type, M 4.

Performances and Losses During the War.

Year.	No. of airships in service. Simultaneously. Max.	Simultaneously. Min.	Total during year.	Scouting trips.	Raids.	Losses caused by— Enemy action.	Bad weather.	Explosion.	Total.	Placed out of commission.
1914	4	1	6	59	—	—	—	—	—	1
1915	13	5	22	389	30	4	4	2	10	1
1916	19	14	31	296	107	8	4	4	16	1
1917	19	11	39	281	46	9	5	—	14	9
1918	11	7	23	123	17	5	1	6	12	3
	—	—	—	1148	200	26	14	12	52	15

During 1914 and 1915 the airships Viktoria Luise and Sachsen, used for training purposes, were employed for short-range scouting duty, but were placed out of commission in 1915.

The total numbers of airships employed during the war were as follows:—63 Zeppelins, 9 Schütte-Lanz, 3 Parsevals, 1 M type. Of this number, 72 were available for scouting duty and raids, the others being detailed for training purposes. Each of these 72 ships made an average of 16 scouting trips and 3 raids. In the Baltic, 24 airships made 220 scouting trips and 41 raids. In the North Sea, 70 ships made 928 scouting trips and 159 raids.

Of the airships lost, 19 were destroyed with all hands; the crews of 6 were taken prisoner, and the crews of 3 were interned in neutral countries. Twenty-four airships were destroyed without loss of *personnel*.

From beginning to end, the German naval airship fleet had sixteen stations with shed accommodation under its control, including the emergency station at Jamboli in Bulgaria. The principal station was at Nordholz, near Cuxhaven, where eventually there was accommodation for six ships of the largest type and two smaller vessels.

country being ridiculously small in comparison with the energy expended. They were even more useless to the German armies in the field, and after the first few weeks they were kept permanently behind the front. That in view of the obvious and speedily demonstrated limitations of the type, and its almost negligible value for any serious naval or military operations, the development of the Zeppelin should yet have been pushed forward so vigorously throughout the war, is something of a mystery. Had Germany, instead of building this fleet of highly vulnerable airships, devoted the equivalent in money, time, and labour to expanding her aeroplane establishment, she would unquestionably have gained a far greater advantage from the military point of view. Details of the various types built before and during the war, and statistics of performances and losses, are given in the tables.

Chinese Engineering Notes.

(From our own Correspondent.)

Peking.

FOR some time there have been indications of considerable activity on the part of the Chinese who were associated in business with the Germans before the war. Germany is fast recovering her pre-war trade with China, and in doing so she is assisted by the methods she has adopted in closely co-operating with the Chinese. Germany always had many Chinese friends, both commercially and politically, and for the past three years they have jointly created sales and other organisations which have been the means of gradually restoring Germany's pre-war trade. It is undoubtedly a fact that most of the present German enterprise in China is an offshoot of the Stinnes syndicate, and the Germans are doing their business in such a way that competition amongst themselves does not exist. A surprising feature is their ability to finance most of the contracts they get and to give long credits—which the Chinese must have. As the Germans can no longer exercise extra-territorial rights in China they enjoy the same privileges as the Chinese, and in this way can own property anywhere in the interior. The Chinese law prevents the natives mortgaging their property to any foreigner enjoying extra-territorial rights, and under these conditions the Germans will benefit very considerably in the future. For instance, there are literally hundreds of such enterprises as mines, cotton mills, flour mills, electric light works, waterworks, &c. &c., which have already been organised, registered, and sanctioned by the Government, but have been unable to raise all the capital that is necessary to purchase equipment, &c. It is very often unsafe to sell machinery for such purposes on a system of extended credit unless ample security is provided quite apart from the equipment itself. This the Germans can and do get by an unqualified mortgage on the whole of the properties belonging to such a company.

Your correspondent is far from being an advocate for the abolition of extra-territoriality. If such a thing ever came to pass, most of us would take the first steamer home. One often hears very pessimistic views about the inability of British manufacturers to compete with German prices, but most people forget that business in China does not always go to the lowest bidder. It generally goes to the firm from which the Chinese can get the best financial terms, and whilst in many cases a British merchant representing the manufacturer is willing to give easy terms of payment, he cannot obtain the sound security that he must have. There is not a single electric lighting scheme in China that does not pay handsomely, and most of them would yield even higher dividends if "squeeze" were eliminated. In spite of this success there are hundreds of towns waiting for electric light and almost as many Chinese companies formed with a proportion of the required capital. These companies require the machinery on easy terms of payment, and the only people who can give it to them now are the Germans, who are willing to do so and take up debentures in the companies in lieu of payment. Arrangements can generally be made whereby a foreign chief engineer controls the operations of the company pending redemption of the debentures. In this way "squeeze" can be reduced to a minimum.

The question now arises: Is there a remedy for this state of affairs or are we to sit still and allow the Germans to capture the cream of the trade which we have had for so long? Nearly three years ago a charter was granted by the Chinese Government to a group of British and Chinese interests which formed the Chinese-British Trade Corporation. Participation in this company was subsequently offered to British manufacturers through the Federation of British Industries, but it appears to have died a natural death through various causes. It is not too late to revive this company and out of it evolve a really workable organisation. Under the terms of the charter it enjoys exceptional facilities for trading in the interior, and whilst it could not very well be used as a selling organisation for a large and competitive group of British manufacturers, it could be used as a parent company from which workable selling concerns could be organised. The company, under its charter, has the right "To finance, manage, undertake or participate in industrial and commercial enterprises of all kinds. To act as intermediaries or agents for the purchase or sale of securities, and for commercial and industrial business of all kinds. To deal in and hold stocks and bonds of all kinds." It will be seen that many practical schemes can be evolved from such a charter, and now is the moment to reopen the question with the Chinese Government.

Steam Turbine Reliability and Design.

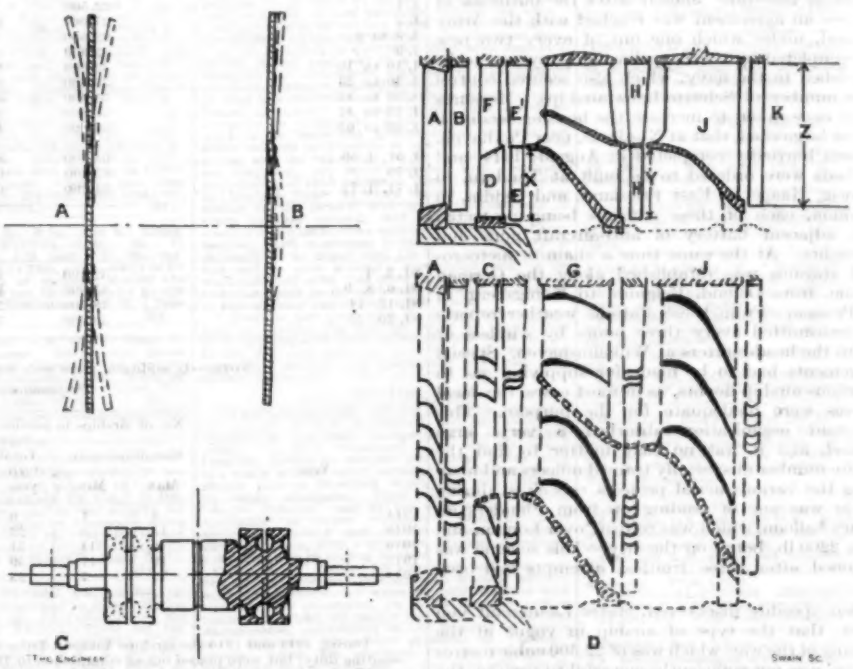
No. II.*

WHEN steam expands through a nozzle from a pressure p to a lower pressure p_1, it acquires a velocity depending on the drop. There is a maximum or critical velocity of about 1476ft. per second, which cannot be exceeded in the throat of a convergent-divergent nozzle; the steam will not pass at any higher rate however much the lower pressure be reduced. The final velocity of discharge through a properly shaped divergent nozzle may be several thousand feet per second if the final pressure be very low, but after a ratio of $\frac{p_1}{p} = 0.58$ is reached (which gives a steam speed of 1470ft.), in order to obtain the full transmutation of the potential energy in the steam into kinetic energy a carefully designed divergent nozzle is necessary; otherwise there may be irregular variations of velocity and pressure in the jet, which result in serious loss of kinetic energy. This loss will arise if the pressure and volumes of the steam flowing through the nozzle are materially altered from the designed condition, and hence will occur under such circumstances as change of load. If, however, the steam speed be kept within about 1470ft. per second, there is no necessity for a diverging exit to the nozzle; it can be made parallel, and, with the exception of the friction loss therein, the potential energy will be converted into kinetic energy without any loss resulting from eddying on the exit side. In single low multiple-wheel turbines, therefore, the number of stages is governed by the necessity of keeping the steam speed well below the critical velocity, and the total heat drop divided by the number of heat units which give the desired velocity settles the necessary number of wheels. This velocity, however, must bear a certain ratio to the blade speed in order to give the desired blade efficiency, and it is this ratio—roughly twice—in association with the permissible blade speed which definitely fixes the steam speed. In the preceding article it was shown how, in the reaction turbine, the blade speeds had gradually risen from about 120–300ft. per second to 135–580ft. at first and last rows respectively. This difference is necessary so as to obtain a reasonably long blade (*i.e.*, minimum percentage leakage loss) at the high-pressure end of the turbine. With impulse turbines, the mean diameter is generally kept practically constant for convenience, and the blade speeds are much higher. They have grown from about 350 to 400ft. per second in about 1904–6 to 600, 700, and even 800ft. per second in the last five years. It is, perhaps, too much to say that 700ft. per second is too high, but the fact remains that in recent practice a number of machines in which it has been exceeded have come to grief. There are no half-measures about a bursting disc at this speed. It means the complete wreck of turbine and perhaps of alternator as well, and sets valued at over £100,000 have been ruined from this cause. The discs, however, are not the only source of trouble. The diaphragms separating them may distort and foul the discs, and if the extent is serious it may mean a bent shaft and broken cylinder. Corresponding to the causes of troubles with reaction turbines discussed in Part I., we may glance at those associated more especially with the impulse type.

Turbine discs have failed on account of one or more of the following causes:—(*a*) Stress due to centrifugal force; (*b*) vibration; (*c*) stresses caused by distortion due to temperature fluctuation; (*d*) defective design, material or manufacture; (*e*) undue local stresses, *e.g.*, round balance holes, or keyways, &c.

The design of high-speed discs is a difficult problem, and in analysing the causes of failure it is often difficult to separate the foregoing influences into their proper proportions on account of their inter-dependent nature. Vibration is undoubtedly a very serious enemy of the disc construction. It may assume various forms or combinations of forms—see sketches A and B—and its prevention demands much heavier scantlings than those necessary from a consideration of (*a*) alone. It may be caused by static lack of balance (a fraction of an ounce will suffice), by the action of the steam, or by vibrations transmitted back from the alternator through the loose coupling. No theory leads one far in determining the exact strength required to avoid these phenomena, but experience has shown clearly that after a speed much over 600ft. per second is passed adequate rigidity is only secured at the cost of disproportionate thickness. Balancing holes are practically inevitable either for static reasons or to counteract leakage which may set up end thrust. With high centrifugal stresses, the local stress round these holes becomes very high, and very little vibration is required to set up an additional stress, which causes rapid fatigue and failure. A number of cases has occurred in which such cracks were discovered by careful inspection in time to avoid rupture. Stresses due to (*a*) are greatly aggravated by those due to (*b*) and (*c*). Mr. Baumann has stated that the Metropolitan-Vickers Company, which experienced difficulties as soon as it exceeded 700ft. per second, subsequently adopted 550ft. per second as a standard mean peripheral speed in its latest units, even those of 12,500 kilowatts at 3000 revolutions per minute. The reduction in diameter which this change entails is, however, only economically possible by the adoption of special arrangements.

The same tendency which led to large-diameter discs had the concomitant defect of introducing large diaphragms between them, and for a given thickness and pressure difference the deflection of a plate diaphragm varies as the fourth power of the diameter. With the increase of blade speed, the steam velocity requires to be increased for the same efficiency; that is, the pressure drop is increased as the square of the blade speed—*i.e.*, diameter—so that the deflection of the diaphragm for a given thickness will increase as the sixth power of the diameter, or to maintain the same deflection the thickness must be increased as the square. All precautions taken to obviate it tend to increase weight and cost. Very little deflection suffices to reduce the clearance which can be allowed between diaphragm and disc, and distortion due to temperature changes is perhaps a more prolific



SKETCHES ILLUSTRATING DISC VIBRATION, FORGED ROTOR, AND MULTI-EXHAUST

* No. I. appeared May 5th.

cause of trouble than that of deflection due to pressure. It has frequently occurred in both land and marine turbines, one instance involving the entire removal for repair of the main turbines from a German light cruiser of 25,000 horse-power. With considerable changes of load or operation the temperature range will alter considerably, and the diaphragms, being immersed in the steam, feel the effect and change their shape more rapidly than the heavy cylinder portions, with resulting alterations to clearances. Experience of this effect showed that both stiffer diaphragms and stiffer discs were necessary. But stiffening them increases the pitch, and with the additional two or three wheels needed to maintain the blading efficiency at the lower peripheral speed the longer span between bearings involves a heavier shaft, and the rotor weight and cost are consequently augmented. From the point of view of mechanical design, the reduction of blade speed with smaller discs and diaphragm diameter has much to recommend it. The difficulty, however, with which the designer is then confronted is that of getting the steam out of the last rows of blades without loss in efficiency due to excessive speed remaining in the steam flowing through the final wheel. As long as large diameters and long blades giving ample area were used, this leaving loss was only small; with the enforced reduction of diameter it is likely to rise considerably unless special measures are taken.

The adoption of a two-cylinder design somewhat tends to favour the reaction turbine in this respect. The recent practice of the General Electric Company has been to adhere to one cylinder even for units of 35,000 and 45,000 kilowatts at 1500 revolutions per minute, and trouble has arisen, as we have seen. It certainly seems unsatisfactory to have to install a second cylinder to contain the last two discs out of twelve, but what is the alternative? Big diameters and high speeds. Now, the bigger the diameter the greater the difficulty of manufacturers and the less can the disc forgings be relied upon to be entirely free from internal forging stresses. The sizes to which some of these discs have grown are shown in Table II.; the largest single-cylinder unit has a last wheel of no less than 106in. diameter with 34in. blades—14ft. 6in. over the tips. Some very large marine turbine rotors have been installed in big liners, but this diameter is nearly as great as anything afloat, as the table shows. Rolled drums, however, at these low speeds and forged discs at nearly six times the velocity are very different problems. In the case of the Parsons 25,000-kilowatt 750 revolutions per minute Chicago turbine, a hollow-forged high-pressure rotor and a 7ft. 2in. drum for the low pressure were adopted. The Lot's-road 15,000-kilowatt 1000 revolutions per minute machine had a built-up low-pressure rotor, consisting of a heavy shaft carrying very substantial discs with wide bosses and rims, each holding several rows of blades; this was for a speed of under 350ft. per second. With the introduction of the 12,000-kilowatt 2400 revolutions per minute turbines at Carville and Dunston, solid forged rotors were adopted for both high-pressure and low-pressure turbines, the former being of the ordinary stepped type 21in. and 29in. in diameter, and the latter, as shown in sketch C, of 34in. and 47in. diameter. Forgings of this nature can, of course, be produced with great reliability in ordinary commercial steel. Special steels cannot be so reliably produced in large sizes, and thus they offer no advantage for adoption in big discs. The shaft of the General Electric Company's 35,000/1500 machine was about 23in. in diameter at the last wheel, and the span between bearings was 13ft. The Carville unit had spans of 11ft. and 10ft. 6in. respectively in high pressure and low pressure. It is also difficult to believe that a rotor which requires erection on site can be as satisfactory as one which has been run under steam in the month before dispatch. The steadiness of running, which is essential to avoid the slightest vibration, can only be secured by robust design and great care in manufacture; vibration is a fundamental source of trouble too important to be ignored, but it does not always arise in the turbine; it may be due to the alternator.

Compared with the drawn brass blades of the reaction turbine—manganese copper is now used at the high-temperature end—the steel blades of impulse turbines have latterly become machined pieces of very considerable weight and cost, and the stresses therein are undoubtedly high. The finish on these details, in order to avoid variations in weight, and to secure the precise fit on circumferences often running into 20ft. and more, is now of a very high order indeed. The attachment of these heavy blades to discs has developed into a fastening of considerable mechanical strength. The largest reaction blades fitted are those 26½in. long in the R.M.S. Britannic's exhaust turbine; impulse blades up to 34in. long were originally fitted in the big Detroit Edison Company's machines, but, when re-built, blades of 28in. were substituted. The reason for these great lengths lies in the necessity of getting the steam out of the extreme low-pressure end of the turbine without sacrifice of efficiency, that is, without too high an exhaust steam speed through lack of adequate area through the blades; but it is also important to ensure that this is not done at the expense of mechanical strength by adopting too great a blade length in relation to the mean diameter at the last row. Some of these relationships are given in Table II. In the Parsons turbine, a blade length greater than 20 per cent. of the mean diameter is rare; in impulse practice much longer blades can be and often are fitted. They require heavy root sections and tapered thickness radially, and often axially, so that the size of the blade openings at root and tip differs very considerably from that on the mean diameter and somewhat affects the efficiency. Moreover, in these long blades vibration in the plane of rotation is liable to be set up through torsional oscillations arising from the generator and transmitted through the loose coupling. This tendency is circumvented in reaction turbines by the introduction of more than one lacing strip. With the high steam velocities employed in impulse blading, the disturbance to steam flow caused by a similar expedient would be excessive, and to avoid these dual disadvantages the Metropolitan-Vickers Company has recently introduced a highly ingenious form of exhaust which seems likely to remove to a large extent the difficulties hitherto met with in single-cylinder impulse turbines without necessitating a second cylinder. Whether this object will be accomplished without sacrifice of efficiency remains, however, to be seen. With the latest construction, increasing the leaving area of the last row by making the low-pressure portion double flow practically doubles the capacity of a machine at a given speed. The Metropolitan-Vickers multi-exhaust, of which more will doubtless be heard, is essentially a method of increasing the leaving area by even more than double if necessary by means of exhausting a portion of the steam circumferentially and the balance axially, the total leaving area being acquired at the expense of additional length and diameter of cylinder casing at the exhaust end, but at the same time obviating the use of large-diameter discs and very long blades with their attendant troubles. In sketch D is given a diagram of this exhaust, which has been fitted to a number of machines installed at Glasgow, Liverpool, and elsewhere. The steam passes through the turbine in the usual way until it reaches the penultimate wheels, where blade length and divergence are becoming considerable. The diaphragm A and blade B are of the ordinary design. The nozzles in diaphragm C, however, are divided into two parts circumferentially. Passing through the outer annulus D, the steam is expanded directly to condenser pressure in suitable nozzles, which direct it on to blades of the usual type at E. Through the inner annulus F the steam is intended to pass without appreciable expansion. The inner portion E of blade E^1 is designed merely to carry the outer part, and passages are left between the blades of such section that the steam issuing from F shall pass through them with the minimum drop in pressure. A corresponding construction is found in diaphragm G; the outer portion expands the steam to condenser pressure, operates on the outer portion of the blades on disc H, and passes thence out of the turbine. Through the inner portion the remainder of the steam passes idly; it is finally expanded to condenser pressure through diaphragm J and wheel K. The sum of the leaving area is thus equal to annuli X, Y, and Z, which, in point of ratio to the area through the last row, can be made to give more space in the proportion of 1.60 for one extra wheel, 2.2 for two, or 2.7 for three extra rows. There are some important advantages which arise out of this construction.

The reduction in diameter of discs and diaphragms largely avoids the difficulties which we have discussed above. For the same revolutions smaller diameters bring lower speeds and lower stresses, stiffer construction is more easily obtained; there is a strong probability of better forgings in the smaller sizes; temperature variations across the working disc are lessened; there is less disc friction and windage loss, less leaving loss due to lower exit steam speed and less diaphragm deflection. The machine as a whole can be made somewhat smaller and more efficient because by reducing diameter it is possible to adopt full-nozzle admission with single-row wheels for first stages, and as the ratio of steam volume to blade height is increased at the high-pressure end, a slightly better performance may be expected.

But all this is not gained without some sacrifice. Reliability is undoubtedly improved by the change, but additional discs and diaphragms are necessary, the length between bearings and hence diameter of shaft is increased, and the cylinder exhaust end is larger and more complicated, all of which affect the first cost in the opposite direction to reduced diameters, while the relative efficiency remains to be proved. It is undoubtedly an extremely clever method of obtaining additional area, but whether it will justify its existence time alone will show.

TABLE II.—*Comparison of Large Electrical and Marine Installations.*

Date.	K.W. or S.H.P. output.	R.p.m.	Installation.	Disc or drum diameters, inches.	Blade height, inches. First row	Blade height, inches. Last row	Maximum overall diameter, inches.	Percentage of last blade length to mean dia.	Mean blade speed, feet per second. First row	Mean blade speed, feet per second. Last row	
1913	25,000	750	Commonwealth Edison, Chicago	H.P. 38, 49, 65 L.P. 86	2½	19	124	18.1	135	345	Largest C. A. Parsons land unit. Two cyls.
				First Last							
1918	30,000	1800	Firth-street, Chicago	— .. 76	—	24	124	24.0	—	787	General Electric Co. Single-cylr. machines.
1917	35,000	1500	Boston Elevated Railway	44 .. 89	—	28	165	23.95	385	766	Ditto, 20 discs.
1918	45,000	1200	Detroit Edison Company	— .. 106	—	34	174	24.3	—	734	Ditto, 21 discs.
1907	40,000*	194	R.M.S. Mauretania	H.P. 96 L.P. 140	2½ 8½	12½ 22	120½ 184	10.25 11.95	83 —	— 127	K. 49.2 } = 103.7 { H.P. and L.P. in series on two shafts. 54.5 }
1913	60,000	170	Aquitania	H.P. 110 I.P. 126 L.P. 144	3½ 6½ 7	7 14 16½	124 154 177½	5.65 9.1 9.45	85 — —	— — 120	28.0 } 27.7 } = 114.5 { H.P., I.P., and two L.P. in series on four shafts. 39.6 }
1914	20,000	180	Britannic	L.P. 150	10	26½	203	13.05	131	139	40.75. Exhaust turbine taking steam from two four-cylinder triple-expansion engines of 18,000 I.H.P. each.
1908	24,000*	675	Torpedo-boat Destroyer	H.P. 40 L.P. 59	1½ 6½	9 14	58 87	18.37 19.2	123 —	— 215	43.6 } = 89.5 { H.P. and L.P. in series on two shafts. 45.9 }

* Two engines of this size per ship.

New Sewage Pumps at Richmond.

ON Saturday last two additional sewage pumps were formally put into service at the Kew Gardens works of the Richmond Main Sewerage Board. We have on several occasions, notably in our issues of July 8th and 15th, 1910, referred to these interesting works and the pumping plant in them, but before going on to describe the new machinery it may be of interest if we refer briefly to the previously existing pumping arrangements. In this connection the plan given in Fig. 1 will be of service.

When the works were officially opened in 1891 the plant provided for pumping sewage consisted of three sets of engines driving vertical pumps, each having a capacity of 4 million gallons in twenty-four hours. They are indicated by the letter A in the engraving. The engines are of the compound horizontal intermediate receiver jet condensing type, and each is geared to two single-acting ram pumps. The high-pressure cylinders are 14in. diameter and the low-pressure cylinders 24in. diameter, the stroke being 33in. They drive single-acting air pumps, 14½in. diameter by 16in. stroke. The pump plungers are 24in. in diameter and have a stroke of 5ft., their displacement per foot being 19,539 gallons. Each engine is fitted with a fly-wheel 12ft. in diameter, weighing about 8 tons, and is capable of running down to a speed of 12 revolutions per minute. The necessary valves and by-pass pipes are provided so that the high-pressure cylinders may be worked direct to the condenser in the event of a breakdown to the low-pressure engines and *vice versâ*. The power is transmitted to bell cranks by cast iron spur wheels and pinions working an intermediate shaft. The pumps are of the single-acting ram pattern. The suction pipes are 24in. in diameter and the delivery pipes 21in. The pump is surmounted by an air vessel on the delivery chamber, 5ft. by 2ft. 6in. inside diameter. The suction chamber is also provided with an air vessel 5ft. 9in. by 1ft. 3in. The valves are hanging flaps with leather beats and hinges. On trial these pumping engines gave an overall mechanical efficiency of 65.3 per cent.

In 1895 additions were made to the plant by installing a three-stage expansion vertical pumping engine of the Worthington type, indicated by the letter B in the engraving Fig. 1, which had a contract capacity

of 12 million gallons per day. By means of an ingenious air balancing apparatus lately added, in substitution for the original weight, the engine has been made capable of pumping 25 per cent. more water if necessary. In the same year there was added a simple direct-coupled centrifugal pumping engine capable of delivering 4½ million gallons per day 20ft. high.

The Worthington engine has cylinders 12in., 17in., however, that the engines are of the four-cylinder vertical type, the diameter of each cylinder being 11½in. and the stroke 14in. They were designed to give their full load at a speed of 250 revolutions per minute when working on gas having a value of 600 B.Th.U. per cubic foot. As the result of tests they were found to give a mechanical efficiency of 88.5 per cent. at full load, of 85.6 per cent. at three-quarter load, and of 78.2 per cent. at full load. The pump will raise 10 million gallons of sewage per day.

Just recently the pumping capacity of the plant has been further increased by the provision of two electrically driven pumps in place of the steam-driven centrifugal pump installed in 1895. The new pumps, which are illustrated in Figs. 2, 3 and 4, are 14in. low-lift centrifugals, arranged to run between 520 and 650 revolutions per minute, the speed variation being obtained by shunt control. The pumps have cast iron

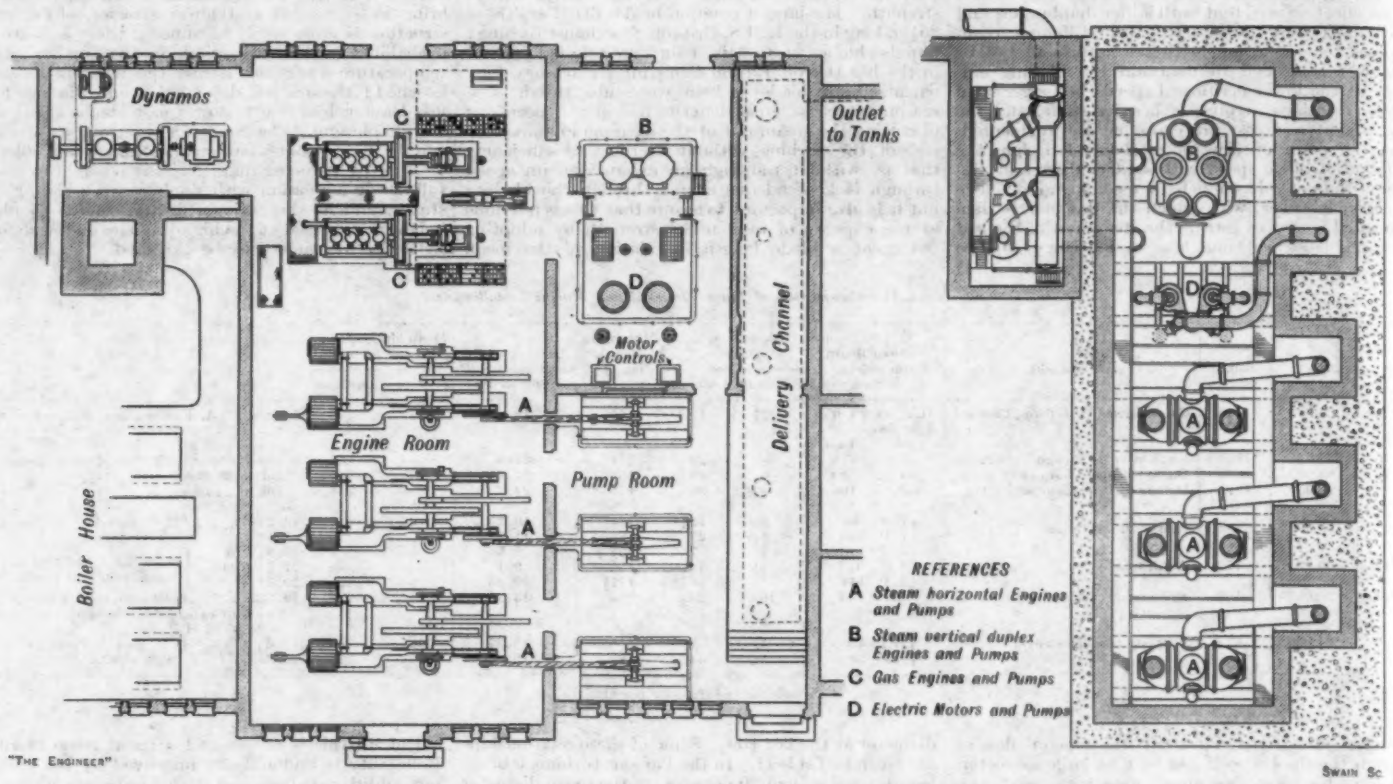


FIG. 1—RICHMOND SEWAGE WORKS—PLAN OF ENGINE-ROOM AND SECTIONAL PLAN OF PUMP WELL

and 28in. in diameter and a stroke of 36in. The pump plungers are 30in. in diameter and the stroke 36in., the displacement per foot being 30.354 gallons. The contract speed was 22.87 revolutions per minute. On trial the engine developed 119.41 pump horse-power and had a mechanical efficiency when working with saturated steam of 87.4 per cent. The centrifugal pump was coupled direct to a vertical high-speed engine having a single cylinder 11½in. diameter and a stroke of 9in. The diameter of the impeller was 38in. and the speed 255 to 260 revolutions per minute. This pump has recently been removed to make room for the new electrically driven pumps described hereafter.

In 1910 further additions were made to the plant in the form of two gas engine-driven pumps, which were described in some detail in the issues of THE ENGINEER above mentioned. We may say here, gas consumption at full load with gas of 550 B.Th.U. calorific value was 17.86 cubic feet per brake horse-power. This in terms of 600 B.Th.U. represents 16.37 cubic feet. At three-quarter load the figure was 18.47, and at half-load 21.59 cubic feet respectively. The engines, see letter C, are started by compressed air from a two-stage steam-driven air compressor, which provides a final pressure of 200 lb. on the square inch. Between the first and second stages of compression the air is passed through an intercooler, and the fully compressed air is delivered into an air receiver arranged beneath the engine-room floor. Each engine is connected through Citroën double helical gear and vertical shaft to a centrifugal pump in the pump chamber under the engine-room floor. The ratio of the gearing is such that with the engine running at 250 revolutions per minute the pump will run at 360 revolutions. When doing full load each impellers, renewable gun-metal rings, bushes and sleeves. The pump shafts are provided with thrust bearings and are supported by ball-bearing guides from steel supporting structures in the well, and fitted with flexible couplings at the pump and motor ends. By this arrangement neither the motors nor the pumps have to bear any of the weight of the shafting, and beautifully smooth running is obtained. Each pump suction is provided with a non-return valve and the delivery with a sluice valve, the latter being operated from the engine-room floor through a vertical shaft gear and column. The pumps are charged by a steam ejector, or alternatively by the use of compressed air from the receiver of the gas engine pumps above mentioned. Mechanical lubrication is provided for shafts and pump bearings, and it is, so we were informed on the occasion of our visit, giving great satisfaction.

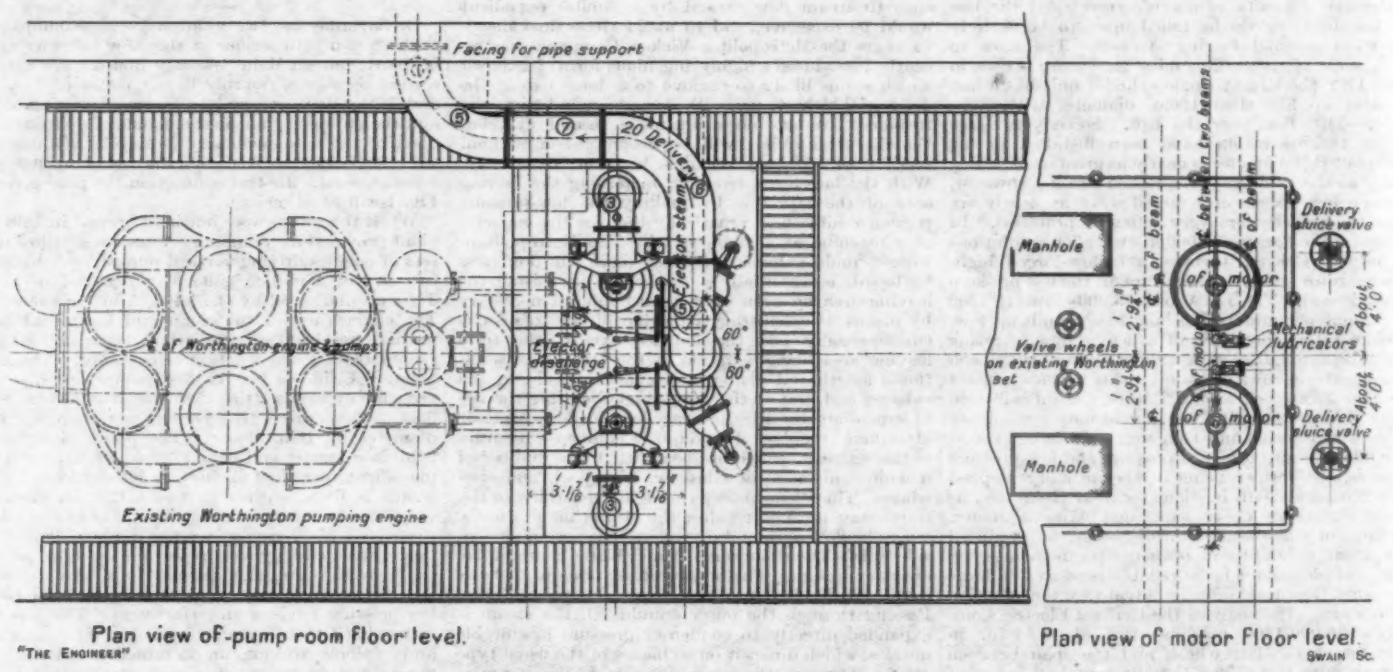


FIG. 2—GENERAL ARRANGEMENT OF NEW CENTRIFUGAL PUMPS

The pumps are capable of lifting 3 to 5 million gallons per twenty-four hours according to working conditions, dependent upon speed and head. The motors, which are direct-current, enclosed, ventilated, vertical-type four-pole shunt-wound machines, are provided with end shield type ball bearings and ball thrust bearings. They are rated to develop continuously from 46 to 75 brake horse-power when running at speeds of between 520 and 650 revolutions per minute on a 420-volt direct-current supply. Each motor has its own control pillar consisting of a metal case standing on the floor and totally enclosed with hinged glazed doors. Each pillar has a ratchet

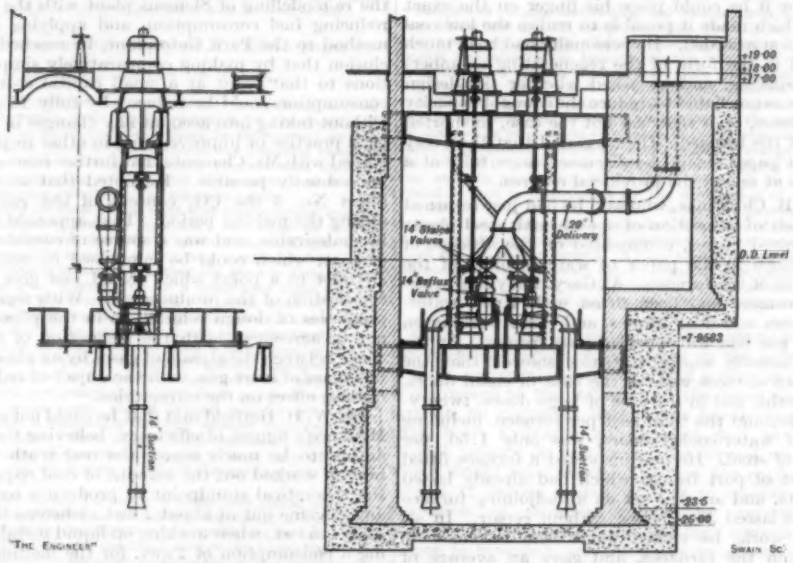


FIG. 3—SIDE AND FRONT ELEVATION OF NEW PUMPING PLANT

type starter, a no-volt release, a double-pole overload circuit breaker, an ammeter, and a shunt field regulator. The efficiency of the motors at 75 brake horse-power is 90 per cent., and at 46 brake horse-power 87.5 per cent., and the temperature rise after a six hours' full-load run does not exceed 81 deg. Fah.

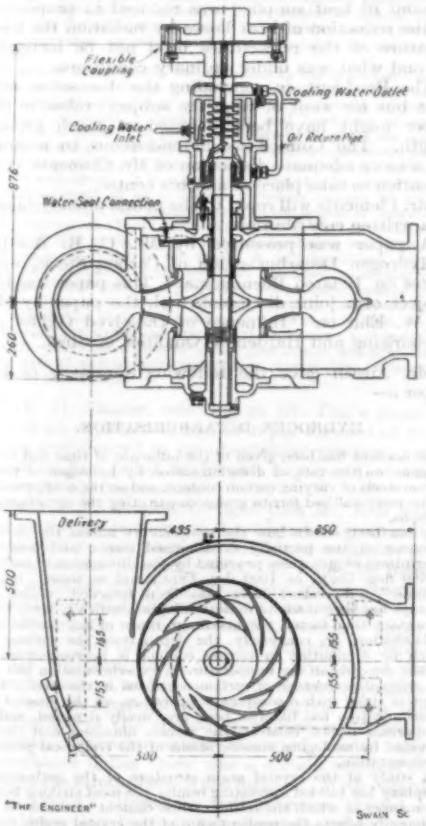


FIG. 4—SECTIONS THROUGH CENTRIFUGAL PUMP

The stipulated conditions under which these pumps had to work are as follows:—

	A.	B.	C.
Capacity per 24 hours, gallons	3,000,000	4,000,000	5,000,000
Depth of sewage in well	3ft.	10ft.	15ft.
Maximum head, including friction	42ft.	39ft.	36ft.
Revolutions per min.	550	535	535
Efficiency of pump	70 p.c.	78 p.c.	78 p.c.
Efficiency P.H.P. / B.H.P.	66 p.c.	73 p.c.	73 p.c.

On trial under these conditions the following results were obtained:—

Condition.	A.	B.	C.
Depth of sewage in well	5ft. 1in.	9ft. 11in.	14ft. 1in.
Total head	44.19ft.	40.73ft.	37.32ft.
Gallons pumped per 24 hours	2,925,000	4,237,500	5,315,616
Gallons per minute	2031.25	2942.7	3691.3
Motor efficiency	87.5 p.c.	87.5 p.c.	88.2 p.c.
P.H.P.	27.2	36.3	41.74
B.H.P.	40.82	47.44	54.63
Kilowatts per hour	34.72	40.46	46.215
Average revolutions per minute	543.3	536	540
Efficiency of pumps and shafting	66.63 p.c.	76.52 p.c.	76.4 p.c.

The electric current is taken from the mains of the Barnes District Council, which brings its supply to a meter house just inside the main gates of the sewage works. In this meter house are the main switch and fuses, so that the whole supply to the works can be cut off when necessary. The switch has a normal carrying capacity of 200 ampères at 500 volts. From this switchboard the current is conveyed by a 37/16 paper insulated cable of a capacity of 210 ampères to an ironclad fuse board fixed on the engine-room wall between the motor control panels. The wiring between the distribution board and the motors is carried in a screwed steel conduit, the cables to the motors being 19/.072 V.I.R. (97 ampères) with shunts 7/20 S.W.G.

The contractors for the new plant were Worthington-Simpson, Limited, of Queen's House, Kingsway, London, W.C. 2, the Brush Electrical Engineering Company, Limited, of Loughborough, being sub-contractors for the motors, &c. It is worthy of note that the former company has supplied all the pumping machinery which has been installed in the works at various periods. The full capacity of the pumping plant at the works is now:—

Power.	Capacity. Million gallons per 24 hours.
Steam	26
Gas	20
Electric motor	10
Total	56

We may add that by slightly increasing the speed of the electrically driven pumps they can be made to lift as large a volume as the three original sets of pumps, indicated by A in Fig. 1, together. The comparison of the relative floor space occupied is instructive, especially when it is remembered that room for the boilers has to be provided for the steam plant.

We have to acknowledge our thanks to Mr. William Fairlie, M. Inst. C.E., the Engineer to the Board, for the facilities courteously granted to us for inspecting the plant which has been installed to his designs and specifications, and for the drawings from which our illustrations have been prepared.

The Cunard Liner Berengaria.

THE conversion of the Berengaria from coal to oil fuel burning and the re-tubing and modification of her boilers has recently been completed by Sir W. G. Armstrong, Whitworth and Co., Limited, at their High Walker shipbuilding yard. The work is of interest on account of the size of the vessel, which is the largest that has ever visited the Tyne, and also because the work on the boilers constituted the largest boiler repair contract that has been carried out on Tyneside.

The Berengaria, originally the Imperator, was built in 1912 by the Vulcan Company, of Hamburg, for the Hamburg-Amerika Line. She is 919ft. in length, 98ft. in breadth, has a moulded depth of 63ft., and a gross tonnage of 52,000 tons. Her boiler installation consists of forty-six Yarrow type water-tube boilers arranged in four rooms, each 75ft. long, which extend, with the newly constructed oil storage tanks that replace the coal bunkers, over the whole width of the ship. A considerable amount of structural alteration has been necessary in order to effect this conversion, as well as to fit new boiler fronts and burners and the necessary installation of pumps and piping. There are in all thirty-two tanks, including twenty-four storage tanks and eight settling tanks, having a combined capacity for 6200 tons of fuel oil, which is a sufficient amount for one Atlantic journey, allowing a good margin of oil in the case of delay through bad weather.

A ring main, formed by 8in. lap-welded steel piping, is carried right round the boiler-rooms with cross connections in each boiler-room and connections to each tank for filling and transferring purposes. There are also four connections to deck, two on each side of the vessel, for connecting to the oil barges or steamers when bunkering. At the beginning of the voyage, all tanks are filled with the exception of one tank port and one starboard, which are only partially filled, and which act as overflow receivers for their respective sides of the ship.

Heating coils of 2in. solid drawn steel tubes are fitted in all tanks; those in the storage tanks are for the purpose of making the oil more fluid, especially in cold weather, otherwise it would not flow to the pumps. In the settling tanks the purpose of the coils is to separate out any water which is intimately mixed with the oil; this process taking place at a temperature of about 85 deg. Fah. The water, being heavier than oil, falls to the bottom of the tank, and is drawn off to the bilges by means of a spring-loaded valve.

There are two settling tanks in each boiler-room, one being in use for supplying fuel to the boilers, whilst the other is being heated for water separation. A special feature of these heating coils is the absence of joints inside the tanks; consequently there is no danger of oil leaking into the steam range. Steam for heating is taken from the auxiliary steam range, and is reduced to 50 lb. pressure before entering the coils. From the outlet of the coils, the condensed steam is discharged by means of steam traps into large observation tanks, where the freedom of this water from oil can be observed before allowing it to flow by gravity into the reserve feed tank. From the reserve feed tanks the water is pumped to the main engine hot well tanks and thence to the boilers, or, alternatively, direct to the boilers by means of the auxiliary feed pumps.

Each of the settling tanks has a capacity of from 156 to 202 tons, sufficient for a full-power run of 22–29 hours. The oil is pumped from the storage tanks to the settling tanks by means of four Weir's vertical oil fuel transfer pumps, each being capable of delivering 100 tons of oil per hour. The oil is then taken from the settling tanks by means of the pumps in connection with the oil-burning plant, of which there are three sets in each boiler-room; two sets in each boiler-room being sufficient to maintain steam for 75,000 shaft horse-power in ordinary work at sea, and the third sets acting as stand-bys in case of damage to one of the others. This system of oil burning is known as the "White low-pressure system," and the plant has been supplied by the White Patent Oil Burning Company. The pump now discharges the oil through heaters, where it is heated to about 200 deg. Fah., and after passing through filters is conveyed by pipes to the burners on the furnace fronts, from which it is discharged at a pressure of 50–70 lb. There are five burners on each boiler (a total of 230 in the vessel) which spray the oil in the form of a fine mist, which, mixing with the air, provides the necessary constituents for maintaining the flame. The products of combustion pass over the outside of the tubes in the boiler and thence up the funnel.

Each of the oil fuel storage and settling tanks is fitted with a Pneumercator apparatus and gauge for reading the depths and quantities of oil in the tanks; these gauges being fitted in the stokeholds near the pumps. The tanks are also fitted with gauge glasses and thermometer tubes; the settling and overflow tanks are each fitted with a float gauge and an electric alarm indicator, the latter giving audible warning when the allotted amount of oil has been run into each tank. Air pipes and steaming out connections for cleaning purposes are also provided.

The ventilation of the boiler-rooms has been modified by using forced draught with a closed stokehold, the previously existing forced draught and ventilator fans being retained. The air from the stokehold as now arranged passes through tubes in the boiler uptakes, where it is heated before issuing into the combustion chamber of the boiler and mixing with the oil. With a view to obtaining the best economy in fuel burning, CO_2 recorders are fitted in each boiler-room. In order to remove any gas fumes from below the stokehold floor and above the oil tanks, exhausting fans with separate suction and delivery trunks have been provided. The fire-extinguishing arrangements are in duplicate, a complete "Firefoam system," capable of distributing a liberal supply of foam over each boiler-room floor, having been installed; while, in addition, means are provided by which steam taken from the high-pressure pipe line can be sprayed all over the spaces beneath the stokehold floors.

Practically all of the boilers have been re-tubed, a process which necessitated the cutting and replacing of over 43,000 tubes. A number of machine tools were specially adapted for cutting the tubes and finishing the ends, and the system evolved enabled a rate of re-tubing to be maintained corresponding to the re-fitting of between six and seven boilers per week. Two Caird and Rayner evaporators, each capable of distilling 100 tons of fresh water every twenty-four hours, have been added to the pre-existing battery of evaporators, and salt water detectors have been fitted to the feed tanks. The arrangements of the feed water and drinking water tanks have been modified in order to remove all fresh water from the proximity of the fuel tanks.

In addition to the work on the boilers, a large amount of re-fitting to the general cabin accommodation has been carried out, and the deck arrangements and boat stowage, &c., have also been materially altered and improved. A new wireless installation by the Aerio Company has been fitted.

The Berengaria arrived on the Tyne on October 31st, 1921, and left at the end of last month, the complete conversion, overhauling, and re-conditioning having occupied some six months. She is now docked at Southampton, and is expected to take up her first sailing of the season from Southampton on May 20th.

Iron and Steel Institute.

No I.

THE annual meeting of the Iron and Steel Institute was held at the Institution of Civil Engineers on May 4th and 5th, under the presidency of Mr. Francis Samuelson.

In presenting the Bessemer Medal to the Secretary of the Japanese Embassy on behalf of Professor Kotaro Honda, to whom it had been awarded this year, the President said that the work of the great Japanese metallurgist was familiar to all engaged in the industry. His researches had been largely concerned with the magnetic properties of iron and steel. He had established the theory of molecular magnetism, based on the measurement of the amount of change of the volume in the steel when magnetised, and his researches led to the discovery of one of the best materials for the manufacture of permanent magnets. He had also directed extensive investigations with the object of elucidating the nature of the A_2 transformation of steel. Professor Honda enjoyed a wide reputation as an instructor and teacher of metallurgical science, and it was owing to his efforts that the great iron and steel research Institute, with its well-equipped laboratories, was established at Sendai University some years ago.

After the delivery of the presidential address, which was reprinted in last week's issue of THE ENGINEER, the reading and discussion of papers was proceeded with.

The first paper on the agenda was that on "British Siemens Furnace Practice," by Mr. Fred Clements, an abstract of which appears below.

BRITISH SIEMENS FURNACE PRACTICE.

At the annual meeting of the Institute in 1920 the author had the privilege of reading a paper entitled "British Blast-furnace Practice," and it was his intention at that time to follow this up with a similar investigation into Siemens furnace practice as soon as opportunity permitted. He makes no apology for reverting to this very important subject, despite the fact that many new Siemens furnace installations have been put in during the last few years; for, whilst an examination of these shows a growing appreciation of the need of better mechanical detail in furnace construction, they follow well-established precedents as far as furnace proportions are concerned, and do not show any material advance in thermal efficiency over what has been obtained in the older plants. It is therefore towards the object of formulating some of the underlying principles which govern the design of regenerative furnaces, deduced from data obtained from good modern practice and by thorough analysis of the work done in the 60-ton furnaces at the Park Gate Works, that this paper is directed.

Arrangements were made to carry out tests at Park Gate, and for this purpose "K" furnace was selected, as it had recently been put into service again after complete repairs to body and chequers. Thermo-couple pyrometers were installed at all points where necessary, and they were wired to a central indicating station. Special tubes were inserted and equipped with fittings so that gas samples could be taken easily. Manometers were also attached so that they could remain undisturbed during the period of the test. A mild steel box was built over the air reverse valves, and all the air passing into the furnace through the valves was caused to enter the box through a mild steel pipe into which was inserted a Pitot tube. The Pitot tube, together with the curved tube rate of flow indicator, were supplied by George Kent, Limited, of Luton, and were guaranteed to give readings accurate to 0.5 per cent. This instrument was found to be in every way very satisfactory. The time was noted at which each hopper of coal was charged into one or other of the three producers which are isolated to provide the gas for the furnace, and as this occurred on each producer at intervals of about fifteen minutes and the weight of coal was accurately known, it formed a convenient way of estimating the rate of fuel consumption. A testing staff was organised and divided into shifts, thus enabling the observations to be taken continuously over three heats. The heat which showed the most consistent set of data has been selected for analysis. It may be stated here that it is not proposed to deal with the chemical side of steel manufacture except in so far as may be necessary to make clear any points which may bear on the main purpose of investigating the Siemens furnace as a thermal machine.

The synopsis of the paper is as follows:—

(1) The consideration of the balance of the chemical operations in the furnace hearth during heat K 3845.

(2) The consideration of the heat balance deduced from the chemical balance in (1).

(3) The consideration of the heat balance of the furnace under the conditions averaged over one half-hour selected during the working period, and the determination of the heat distribution throughout the system at that time.

(4) The consideration of the detailed schedules of British Siemens furnace practice along with information calculated from the data.

(5) The consideration of a suggested design for a furnace with a hearth capacity capable of producing 100 tons of ingots per heat.

The need for systematic research work into all the operations connected with the production of steel in the open-hearth furnace becomes very evident when an investigation such as that under consideration is undertaken. The paucity of reliable and consistent data renders the task of elucidating the results very arduous, and a combined effort ought to be made by steel makers to systematise investigations. The full advantage could then be derived from the work done and the repetition of any unnecessary work avoided, so that the maximum result in progress could be looked for. This desirable end can only be attained by the united effort and support of steel manufacturers, as it is far too great a task for any one man, or indeed any one firm, to carry out. It is only by such effort that the improvement in economy of manufacture which is urgently necessary can be achieved. The paper is accompanied by a number of large sheets of graphs, tables, diagrams, and drawings of furnaces, &c., and is an exhaustive treatment of the whole subject.

Mr. E. H. Saniter welcomed the paper as the most important contribution which had yet been made to the literature of blast-furnace practice. Referring to the graphs showing the consumption of gas and air, he said that nothing of the kind had ever been produced before, and it was not, therefore, perhaps, surprising that the results arrived at differed from pre-conceived ideas. In the charging period it was shown that there was a very high consumption of gas and air, while in the melting period the gas consumption was low and the air consumption was high. With regard to the rapid drop in the temperature of the chambers that was perhaps a little exaggerated, and he noted that on Sheet 5 the author had only taken credit in his thermal balance sheet for burning the carbon into CO instead of CO_2. Radiation losses were shown on page 6, and it would be very interesting to have some definite practical information as to the effect of insulating the roof with bricks; he feared that the side linings would waste away much more quickly under such circumstances. With regard to Sheet No. 9, dealing with coal consumption, the whole subject required further investigation, and he asked the author if he could place his finger on the exact feature which made it possible to realise the low coal consumption recorded. He personally had been much interested in the form of the regenerating chambers and the spacing, and he asked whether the design adopted was not liable to reduce the draught capacity of the furnace, or, if that was not the case, to shorten the life of the furnace. He suggested that that very important paper should be discussed more fully at a later date at one of the provincial centres.

Mr. E. B. Christmas, who said he had just returned from a visit of inspection of open-hearth steel plants in the United States, commented on the absence of any reference in the paper to water cooling of the refractories of the furnace. At Gary, forty-five open-hearth furnaces had been fitted with Knox water-cooled doors and door frames, and those working on producer gas had water-cooled port frames. At the Edgar Thomson works, statistics showed that the life of such devices was, in the case of small doors, forty months, and in the case of large doors, twenty-six months, and the total cost per furnace, including repairs of water-cooled doors, was only 1.5d. per long ton of steel. He had inspected a furnace fitted with a set of port frames which had already lasted 2038 heats, and another set on an adjoining furnace which had lasted 2008 heats, without repair. In all the steel works he visited waste heat boilers were installed on the furnaces, and gave an average of 350 horse-power from furnaces of 75 tons nominal capacity. That boiler capacity was obtained at practically no cost. There was a tendency in America at the present day to abandon the use of valves in which the gases, either new gas and air, or waste gas, had to bend at an angle of 90 deg. in their course. It was found that those angles caused a big drop in the draught and in the temperature of the gases. It seemed probable that during the next two or three years most of the furnaces would have the damper type of valve fitted, so that all gases would pass through without any bend. The Orth roof was much liked in America, and attention was being given, on an experimental scale, to new designs of furnaces.

Dr. A. McCance referred to the author's figures dealing with heat balance, which he feared had been calculated on a wrong basis. The only proper way to compile a thermal balance sheet was to calculate the heat put into a furnace and that taken out, and it seemed clear that there was an error in the author's figures, probably owing to a wrong assumption in working out the heat losses by radiation. With regard to the efficiency of the furnace, the figure he obtained was 32.3 per cent., which, he believed, was much nearer the truth than the author's figure of 16.9 per cent.

Mr. F. W. Harbord said that the paper made a great appeal to him by reason of its educational value. Mr. Clements first calculated the theoretical ideal conditions, and then proceeded to consider how they could be realised in actual practice. Further investigation might probably show that the various percentages of loss could be considerably modified. The question of radiation was admittedly a very difficult one, and if water cooling was adopted the losses under that head would be increased. A more hopeful line of development was to obtain refractories which would withstand higher temperatures. Another serious source of loss was the gas escaping from the furnace, and the remedy suggested by the author was to reduce the volume of the gases. Another method would be that of obtaining cheaper oxygen and using it to reduce the large amount of inert nitrogen, which was going into the furnace and carrying away large quantities of heat. The question of the velocity of the gases was also an important one which had not yet been dealt with on a satisfactory basis, although suggestions for providing remedies had now been put forward.

Mr. Benjamin Talbot dealt with the question of fuel consumption, and said that if it could be got down to 2 cwt. per ton of ingots it would be welcomed by all steel makers. With regard to the restriction of the bottom end of the regenerators, there would be practical difficulties owing to dirty gases if that suggestion were adopted.

Mr. J. A. Smeeton referred to the advantages of a new type of furnace designed on the multi-flame principle, which, he claimed, would melt steel with minimum losses from radiation. The principle of that furnace was to bring the whole of the heat in direct contact with the bath, and put it into the metal, and use the waste heat on a continuous recuperative furnace system. The heat contained in the waste gases would be utilised to heat up the air and gas. He would insulate the furnace roof by covering it with a thick layer of sand. Such a furnace would be capable of melting steel on a fuel consumption of 3 cwt. He had, indeed, already proved in tests which had been carried out that he could effect a saving of fuel consumption in many steel works operation of 85 per cent., and could reduce the fuel consumption of any furnace by 40 per cent. Within the next few months he hoped to be in a position to put a practical furnace of the type indicated before steel makers.

Mr. H. M. Ridge expressed the opinion that the paper contained more complete data on the heat distribution of the Siemens furnace than had ever previously been published, and hoped that the suggestion to discuss the subject more fully at a later date would be adopted. He had been associated with the re-modelling of Siemens plant with the object of reducing fuel consumption, and applying the same method to the Park Gate plant, he reached the conclusion that by making comparatively simple alterations to that plant at a small capital cost the fuel consumption could be reduced by fully 26 per cent., without taking into account any changes in metallurgical practice or improvements in other respects. He agreed with Mr. Clements that further economies were undoubtedly possible. He noted that according to Sheet No. 3 the CO_2 content of the gas dropped during the melting period. That appeared to him to be undesirable, and was a source of considerable loss of heat, which could be minimised by reducing the air inlet to a point which would just give complete combustion of the producer gas. With regard to the principles of design referred to in the paper, he was not in agreement with the suggestion of filling the space between the stream of gases by an almost immobile mass of inert gas, with the object of reducing the heating effect on the refractories.

Dr. W. H. Hatfield said that he could not accept Dr. McCance's figures of efficiency, believing those of the author to be much nearer the real truth. He had himself worked out the amount of coal required from the theoretical standpoint to produce a ton of steel, and it came out at about 1 cwt., whereas the author gave 4.5 cwt. when working on liquid metal. Assuming a consumption of 2 cwt. for the melting process, that would give an efficiency of between 17 and 18 per cent. He believed that the author was justified in assuming that in the new furnace which was being designed it would be possible to bring the fuel consumption down to 3 cwt., which would be a remarkable result.

Dr. W. Rosenhain referred to the suggested difficulty of applying heat insulation to steel furnaces owing to the effect on refractories. He pointed out that the damage to refractories was mainly a question of the temperatures which they reached, and if the amount of heat supplied was reduced in proportion to the reduction of heat losses by radiation the temperature of the refractories need not be increased beyond what was under ordinary conditions.

The President, in concluding the discussion, said that but for want of time the subjects raised in the paper might have been debated at much greater length. The Council would endeavour to arrange for a more adequate discussion of Mr. Clements' contribution to take place at another centre.

Mr. Clements will reply to the points already raised in a written contribution.

A paper was presented by Mr. C. R. Austin, "Hydrogen Decarburisation of Carbon Steels, with Notes on Related Phenomena." This paper was the subject of a joint discussion with the paper by Mr. E. W. Ehn on "Influence of Dissolved Oxides on Carburising and Hardening Qualities of Steel."

Mr. Austin gave the following summary of his paper:—

HYDROGEN DECARBURISATION.

An account has been given of the influence of time and temperature on the rate of decarburisation by hydrogen of plain carbon steels of varying carbon content, and on the configuration of the recrystallised ferrite grains constituting the decarburised portions.

It has been shown how the temperature affects the microcharacter of the partially decarburised steels, and detailed descriptions of structures provided by the elimination of carbon at 680 deg. Cent., at 1000 deg. Cent., and at some "intermediate" temperature have also been recorded, whilst an attempt has been made to indicate diagrammatically how, with a constant time factor, the maximum range of any partial decarburisation, or, conversely, the depth from the surface at which no diminution in carbon content is microstructurally visible, depends on the temperature of experimentation and on the original percentage of carbon contained in the steel. The effect of time, with a constant temperature, on the amount of decarburisation has likewise been graphically depicted, and a comparison drawn between the results obtained and those provided by analogous considerations of the reciprocal process of cementation.

A study of the crystal grain structure of the carbon-free periphery has yielded interesting results, the most striking being the manner in which the initial carbon content of the steels so profoundly affects the configuration of the crystal grains comprising the hydrogen decarburised material when the removal of the carbon is effected at a subeutectoid temperature.

A theory has been put forward as a possible explanation of the "columnarisation" phenomenon observed, and clearly illustrated in the photomicrographs presented.

Some experimental consideration has also been given to the effect of temperature on the rate of diffusion of carbon, or carbide of iron, in iron; in all instances the medium employed was a partially decarburised hypereutectoid steel presenting a microstructure consisting of a completely decarburised peripheral zone surrounding an apparently unaltered core. The results of this phase of the work have been recorded, and discussed in the light of the work of previous investigators, reasons being stated for the conclusion that a iron must have a real solubility for carbon or carbide of iron; the degree of solubility depends on the temperature, but data has not yet been obtained which admits of a numerical expression for this solubility.

A figure as a first approximation has, however, been deduced

for the diffusion constant or specific diffusive rate of carbon in iron at 650 deg. Cent. and at 850 deg. Cent., based on the application of Fick's well-known law of diffusion.

Decarburisation by means of pure dry hydrogen has been briefly described, and a comparison made between the observations noted and those previously obtained, under similar conditions, when experimenting with the moist commercial gas; that the presence of oxygen is not essential for the production of the peculiar "columnar" feature of the crystal grains is demonstrated in this section of the work.

Decarburisation with a temperature gradient maintained along a steel specimen has incidentally proved one or two ulterior interesting features. The micro-structure of a piece of iron wire which had remained in the furnace during decarburisation presented a very interesting appearance, and presumably provides an example of decarburisation preceded by carburisation in the same furnace and under similar conditions. The salient features of the decarburisation effected during the maintenance of a temperature gradient have also been recorded.

The following is a summary of Mr. Ehn's paper:—

THE CARBURISING OF STEEL.

The results obtained in commercial carburising are, as shown in this paper, very much dependent on the quality of the steel, and as these qualities cannot be determined by the usual chemical or physical test methods, the practical value of a carburising test is obvious. A better product with uniform hardness, less operating trouble, and fewer rejections due to improper hardening, would be the ultimate result.

It is necessary for tests of this kind that microscopical examinations of carburised sections be made; but these do not, if properly conducted, involve a large amount of work, and after a little experience it becomes a very easy matter to determine from the carburised structure whether the steel is suitable for carburising or not. Carburising on a laboratory scale can be carried out in a few hours, especially if some kind of tight-fitting containers are employed in accordance with the recommendations made in the paper. It must be understood, however, that a test of one specimen from a large heat of open-hearth steel is not a perfect safeguard against improper steel, as different parts of a heat often show different carburising qualities. Even one sample from each heat is, however, likely to catch the worst cases, and if several samples from each heat are tested, a reasonable security against improper steel should be obtained. Tests of this kind constitute, moreover, a distinct warning to the steel mills not to send their off-heats to consumers who are known to submit the steel to tests of this kind.

For most carburising purposes, a clean, well made, straight low-carbon steel would be satisfactory, especially if hardened by spray quench to counteract small variations in the steel. Owing to the difficulty of obtaining a steel of this kind of uniform and proper quality in the open market, the author is inclined, however, to recommend for general carburising purposes a steel with 0.30 to 0.50 per cent. chromium. For parts subjected to a very severe service, steels with higher content of alloys such as chromium, nickel and vanadium, can be recommended, although for ordinary purposes out of the question owing to the higher price. A slight percentage of chromium, such as suggested, would give a steel of good carburising properties, as it is very unusual to find a chromium steel with abnormal properties; would not raise the price very much; would rather help than impair the machining qualities, as straight low-carbon steel often tears under the tools, on account of being too soft; would increase the rate of penetration in the carburising somewhat; would be beneficial for the hardening; and, last, but not least, would necessitate carefully deoxidised heats, as otherwise so much chromium would be lost in the furnace that the chromium content in the finished steel is likely to be lower than specified, and thus detectable by chemical analysis.

The author would finally call attention to the important fact that this influence of oxides in steel is not restricted to carburised low-carbon steel only. They will, if present, materially influence the results obtained in heat treating and hardening of any steel. In the paper, the probable influence on grain size and structure of work submitted to tough annealing operations, and on the spheroidising of the cementite in annealing high-carbon steels are mentioned. It is an interesting fact that by carburising high-carbon steels so as to obtain a carbon content of 1.10 per cent. or over, a very sensitive test on the degree of deoxidation is obtained, and that in several instances it has been possible to prove by this method that failures in hardening were due to the presence of oxides in the steel. A well-deoxidised, high-carbon steel should give the structure described as normal in this paper, while abnormal properties are revealed mainly by irregular grain size. Many failures, especially in hardening, are likely to find their explanation on tests of this kind, and perhaps even the mysterious property of steel known as "body" might ultimately be explained by the presence or non-presence in the steel of non-metallic impurities, presumably oxides in solid colloidal solution.

Mr. E. H. Saniter, referring to Mr. Ehn's paper, said that an explanation had been put forward of the troubles experienced in case-hardening practice, but the author had failed to furnish any proof of the accuracy of his contention.

Colonel N. T. Belaiew thought that Mr. Ehn was under a misapprehension on the subject of grain size, as it seemed to him that the difference could not be explained in the way suggested. It would be more correct to state that slag enclosures might exercise an influence on the primary size of the crystals.

Dr. Rosenhain, dealing with Mr. Austin's paper, said he had been interested in the attempt to determine the temperature of incipient diffusion of the iron-carbon alloys, and it was found almost impossible to prevent an appreciable loss of carbon from the outer regions of the specimens experimented with. Apparently, decarburisation occurred under any circumstances unless there was a certain amount of carbon in the atmosphere of the furnace. With regard to Mr. Austin's suggestion that moisture played a part in the action, he could not accept the evidence as being entirely complete. A probable explanation was that diffusion might really take place in the crystal boundaries. Mr. Ehn had endeavoured to show the connection between troubles experienced in case-hardening and structural features, but that those features were due to the causes he suggested could not be accepted on the evidence produced.

Mr. J. N. Greenwood welcomed Mr. Austin's paper as bearing on problems which arose in the annealing of strip and wire. Decarburisation of strip steel occurred under certain conditions in cast iron borings, and the question arose whether it was not possible for a certain amount of hydrogen to diffuse from the borings and produce decarburisation. There was a much simpler explanation of the columnar structure than that given by the author. It was natural for the crystals to grow inwards as the carbon was removed. With regard to the diffusion and solubility of iron carbide in alpha iron, there was an increase in the solubility of alpha iron below 700 deg., and definite evidence of diffusion.

A paper on "The Effect of Oxidising Gases at Low Pressures on Heated Iron," by Professor H. C. H. Carpenter and Miss C. F. Elam was read by the first named. The summary of it, as presented by the authors, is given below.

OXIDISING GASES AND HEATED IRON.

Samples of Armco, electrolytic and Swedish iron were heated from below 900 deg. to above 1000 deg. Cent. in an evacuated quartz tube and oxidised slightly without producing any characteristic crystallographic features on the surface of the metal. If, however, a specimen of copper were introduced as well, containing the gases which are ordinarily present in the metal, a reaction set in resulting in the gradual production and development of characteristic facets on the surface of the iron. These are due to the production of what is probably the oxide Fe_3O_4, which subsequently passes to Fe_2O_3 without change of form. The oxide of iron originally produced is isomorphous with alpha iron, and the orientation of the oxide produced on any given crystal of iron is determined by the orientation of the alpha iron itself. It is, in other words, "a parallel growth" of the magnetic iron oxide. Once produced, the form of the oxide is uninfluenced by heating the specimen to a temperature at which gamma iron is formed. A somewhat similar phenomenon was observed sixteen years ago by Osmond and Cartaud. The principal agent in the production of the characteristic facets of oxide is the mixture of gases evolved by the copper on heating.

Dr. C. H. Desch, opening the discussion, said that the crystallographic observations in the paper were of quite remarkable interest and of a very novel kind. With regard to the influence of the gases that were present, he suggested that it was hardly possible to have both hydrogen sulphide as well as sulphur dioxide present on account of the deposit of sulphur which would take place. Amongst the explanations offered, it seemed a little difficult to conceive of the formation of parallel growths by crystallisation because the temperature was not high enough for the carbon to volatilise, and there was no solvent present. In all cases, so far as he knew, the substance forming parallel growths must be deposited either from the liquid state or from the state of vapour.

Colonel Belaiew regarded the work described in the paper as very important, because it seemed to him that it put a new method into the hands of metallurgists for the study of the structure of iron at high temperatures. It would be remembered how important, some ten or fifteen years ago, were the observations by Dr. Sanitor and by Osmond and others on the etching process. In this paper the authors had brought forward a new method which would enable metallurgists to know what was the actual structure of the iron in the area of high temperature. It was very important indeed to follow that method in the future, because what happened in the area of granulation was not yet quite known. The main point raised by Dr. Desch was whether it was possible for the mixture of gases mentioned to oxidise iron and to produce the crystals. His own opinion agreed with that of Professor Carpenter, and the observations of Osmond tended to confirm that view. It was always very difficult, without knowing exactly the composition of the gases, the temperature, and the pressures, to be quite definite, and it would perhaps be wise to reserve judgment. Putting aside the question whether it was possible to expect oxidation in a particular manner, the fact had to be acknowledged that the oxides were formed. It was interesting to note that under the conditions described by the authors the crystallisation of magnetite would exactly follow the lines of the crystallisation of alpha iron.

Dr. W. H. Hatfield said the paper had described an astonishing phenomenon, but he was quite prepared to accept the explanation put forward. The authors had been contributing papers recently on aluminium crystals, which were really of fundamental importance to metallurgy in general, and he thought if some of their work could be placed before the Institute it would be of value. It was a little strange to suggest that the non-ferrous metals should be dealt with before the Iron and Steel Institute, but the authors work on the growth of single crystals and the intrinsic properties of metals might well be brought before the Institute, and he suggested that consideration should be given to his proposal.

Miss C. F. Elam, in replying to the discussion, said the question of the gas analysis had been raised. The analysis of the gas was done in the Fuel Department of the Imperial College of Science, and was returned to them as hydrogen sulphide and sulphur dioxide. It seemed rather extraordinary that those gases could exist together, but they had been assured that under certain conditions they did so, and that there was no means of distinguishing them by ordinary gas analysis. Professor Desch had suggested the alternative explanation of oxidation of the metal rather than the growth of crystals of iron oxide on the iron. The reason why they had suggested the actual growth of iron oxide crystals, following the orientation of the iron, in which they were growing, was that if it were merely an oxidation of the iron they could not understand why the crystals should go on growing in the same form when they were either below 900 deg. in the alpha range or in the gamma, and apparently the iron could be heated and cooled through that range quite a number of times—five or six times—without any change in the facets when they had been once formed. Another reason for doubting it was the formation of the small crystals. It was of importance to obtain a photograph of them because they stood up from the surface at all angles. She had been very interested in Colonel Belaiew's remarks about magnetite. There was no evidence that magnetite was formed. When the oxide was examined after removing it from the specimen, it was non-magnetic, and the only reason why the authors had suggested that probably magnetite was formed was because magnetite belonged to the cubic system, and the iron oxide, whatever it was, apparently must have belonged to that system when it was formed. The triangles were formed in samples, which were heated for a short time, and they were also found in samples which were never heated above 900 deg., but were heated entirely within the alpha range. She thought it simply depended on the orientation of the crystal in which they grew.

The annual dinner was held in the Connaught Rooms, and appeared to be as largely attended as ever. The toast list was a short one, but as the principal speakers were the Home Secretary (Mr. Shortt), Sir Eric Geddes, and Lord Inchcape, it was full of interest and not lacking in a good measure of humour. Mr. Shortt made the astonishing statement that there was nothing but harmony at Genoa, and that the newspaper reports to the contrary were incorrect, but whether he meant that statement to be taken literally or not we are a little uncertain.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

LOCOMOTIVE PRESSURE GAUGES.

SIR,—I observe in connection with the recent investigation into the Buxton locomotive boiler explosion that amongst the recommendations of the Board of Trade is one that a cock should be fitted on the gauge pipe.

Now it is of the first importance that a gauge pipe should not be susceptible of any interference between the interior of the boiler and the gauge itself; hence it should not derive its pressure *via* any other fitting, nor should a cock be placed on it for the reasons that when testing a boiler in steam after a hydraulic test (of considerably higher pressure—in some cases with the safety valves screwed down solid) such a cock might be left closed, and, in addition, after adjustment of safety valves in service, the cock might be only opened sufficiently to "throttle" the steam to an extent sufficient to falsify the gauge reading.

I enclose a copy of the instructions governing the examination and testing of safety valves and steam gauges in force on these railways, which may be of some interest in connection with this matter. It should be noted in explanation of the air brake foreman being principally responsible that the organisation includes locomotive air brake work, injectors, steam cocks and clack boxes, also sight-feed lubricators, together with safety valves and steam gauges in one section.

P. C. DEWHURST,
Locomotive, Carriage and Wagon Superintendent.
Kingston, Jamaica, April 19th.

[COPY.]

JAMAICA GOVERNMENT RAILWAY, LOCOMOTIVE BRANCH.—GENERAL INSTRUCTIONS.

EXAMINATION AND TESTING OF NEW AND REPAIRED SAFETY VALVES AND STEAM GAUGES.

EXAMINATION AND TESTING OF STEAM GAUGES.

The Air Brake Foreman at Headquarters is responsible for the examination and testing of steam gauges of locomotive and stationary boilers; these tests must be made once every quarter (or whenever gauges show signs of irregular working), and returns must be sent in on the form provided.

(a) Steam gauges must be compared with the test gauge or deadweight tester provided.

(b) Every gauge must have a syphon of ample capacity to prevent steam entering the gauge.

(c) The pipe connection must enter the boiler direct.

TESTING AND SETTING OF SAFETY VALVES.

Safety valves must be tested under steam once every quarter (or whenever they show signs of irregular working), and reports sent in on the form provided.

(a) At Headquarters this work will be carried out by the Air Brake Foreman and at Outside Running Sheds by the Shed Foremen.

(b) Safety valves must be set by the gauge employed upon and belonging to the boiler.

(c) When setting safety valves the water level in the boiler must be below the highest gauge cock or mounting.

(Signed) P. C. DEWHURST,
Locomotive, Carriage and Wagon Superintendent.
1st July, 1918.

RAIL CORRUGATION.

SIR,—Referring to the letter of Mr. D. H. Leigh on the above subject, published in THE ENGINEER of March 3rd, it would appear that the comparison between the examples of rail corrugations found on tramway rails and on bull-headed and flat-footed railway rails under similar and under varying conditions and road beds is the only means of ascertaining the primary cause of corrugation. The conditions which appear to be the cause of, and to which corrugation is attributed in one case, will be found to be entirely absent in another case, although corrugation occurs in both.

In making such comparisons it is necessary to bear in mind that tramway rails differ more widely from railway rails than do the different types of railway rails between themselves. For instance,

tramway rails are generally laid on a continuous hard bed; they are often welded in long lengths; they are boxed up so that only the top of the rail is exposed to heat and cold; the whole of the head of the rail is not a running surface; and super-elevation of the outer rail on curves is not provided to the same careful extent as on railway rails; in fact, super-elevation is often present on straight lengths, directly contrary to mechanical requirements, because of the camber of the road surface.

From personal observations taken on railway and tramway rails at home and on railway rails in the Federated Malay States, the conclusions I arrived at are:—

(1) That the primary cause of rail corrugations is restricted wave motion in the rail, which, being closely allied to the phenomena of rail creep, is dependent on the nature of the road bed, the method of fixation of rails and joints and on the speed and weight of the loads passing over the rail.

(2) There are several contributory causes which accentuate corrugation, such as defective rolling stock, brake action, &c., but none of which can be put down as being the primary cause.

For a more detailed account of the investigations and observations carried out I would refer to a paper read by me before the F.M.S. Section of the Permanent Way Institution, which paper was published in the *Journal* of the "Proceedings" of that Institution in December, 1921, Vol. XXXIX., Part III.

H. DUSCOMBE BINDLEY, A.M. Inst. C.E.

London, April 12th.

RAILWAY BRAKES.

SIR,—I have read with considerable interest the article on "Railway Brakes" in your issue for March 3rd, 1922.

We in India are now face to face with the problem of operating the automatic continuous vacuum brake on all goods trains, and we appreciate very much the matter conveyed in the paper by Sir H. Fowler and Mr. H. N. Gresley on the subject, although we would have preferred to have seen more reference to the actual working of the brake apparatus in regular service. Their remarks apply to trials on specially prepared trains, and there is no doubt very successful working can be obtained under such conditions.

I send two photographs of a train we recently experimented with here, made up to correspond to a 2000-ton load—thirty-seven cars with one four-wheeler van at the rear weighing 10 tons. The total length of "piping" in this case was approximately 1800ft. The dead weight of the brake apparatus on the train may be taken at 50 tons plus a 10-ton vehicle at the rear—total 60 tons. If the train had not been equipped with continuous brakes we should require at least *three* 20-ton "weighted" vans at the end to be on the safe side in case of a break-away; further, as the whole of the vehicles would doubtless be fitted with hand brake gear which would weigh at least 30 tons for the train, the train equipped with continuous brakes possesses an advantage of 30 tons *less dead weight*.

On this particular train 20in. of vacuum was maintained on the engine and 19in. on the rear van, but we find we cannot ensure this vacuum in regular working; therefore all railways have agreed to operate goods trains with 15in. This is the first trouble we have to contend with—maintaining vacuum. Next there is the difficulty of detecting leaks and securing a "tight" train. Then comes the question of release. The brakes can be applied quickly enough, but we cannot release them (*sic*, as quickly?). Other drawbacks as regards the retention of the brake power on long inclines and the possibility of utilising the power brake for shunting, &c., are matters which require serious attention if the vacuum brake is to be adopted generally for goods trains.

The writers of the paper referred to the coupling troubles, and it is imperative that these should be removed if continuous brakes are to be introduced; hence the present proposition before the Government of India of introducing mechanical couplers to secure practically tight coupling on impact, and there is no doubt this will have to be done if successful working of heavy goods trains with continuous brakes is to come. Screw couplings may be all right for passenger working under passenger conditions, but they are hopeless under rough-and-tumble methods of the goods service; they never are tight and never will be.

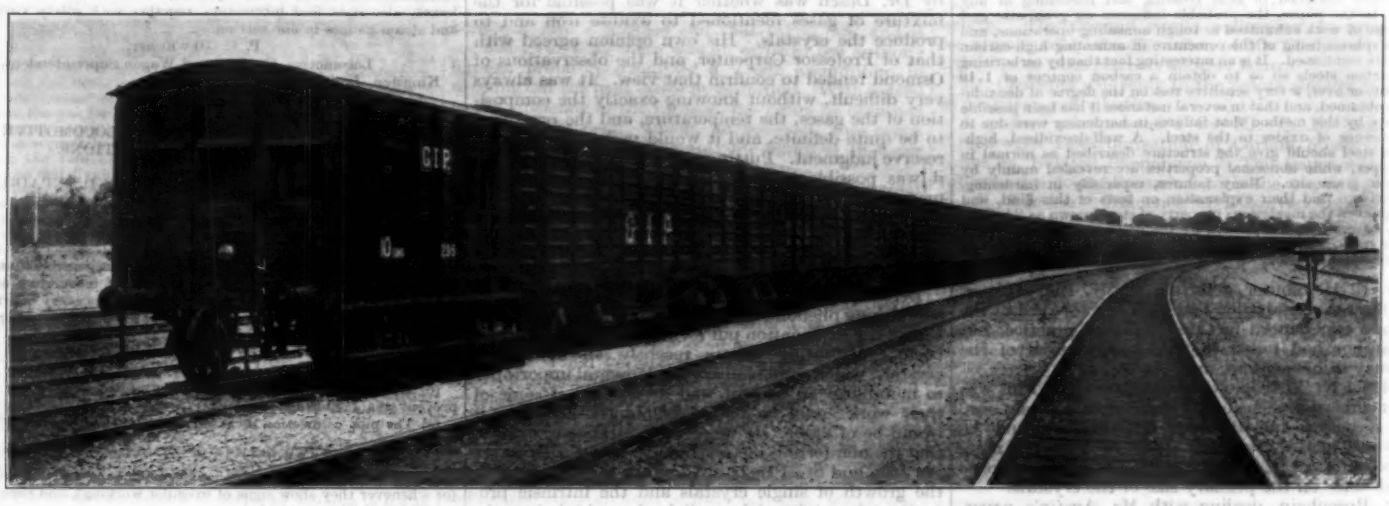
You refer to the necessity for brake equipment for goods stock to be arranged with some simple and efficient double capacity braking device. We have experienced this want, and owing to the fact that a large number of vehicles are offered at junction stations which cannot have the brake apparatus put into working, we are meeting this difficulty by providing sufficient controlling power at the front of the trains for the heavy inclines they have to descend. We do this by equipping a number of high-capacity bogie wagons with the double brake arrangement of the A.V.B. Co. Each wagon has four cylinders—two of 18in. diameter, to take care of the wagon when empty, and two of 24in. diameter, to assist to bring up the braking power for the wagon when loaded. By utilising these wagons for the carriage of locomotive coal over certain sections we can secure the brake power we require without having to refit such a great number of foreign vehicles at the last junction station of the section.

As you remark, the fitting of passenger trains with continuous brakes is not difficult, but with the goods service the case is a very different one, and I am inclined to think with you that much more attention to it is required. In the United States there is no doubt considerable experience has been gained owing to the fact that the law compels all trains, passenger and goods, to be fully equipped with power brakes. In India, unfortunately, we have no compulsory law at present, although we are anxiously expecting an order from the Railway Board that the brakes must be put into operation on *all* trains. When that occurs we shall have ample opportunity of thoroughly testing the merits of the vacuum system for heavy goods trains. Until such a time does arrive our efforts must be considered as very second rate and indefinite.

A. M. BELL,
Carriage and Wagon Superintendent,
Great Indian Peninsula Railway.

Matunga (Bombay), April 21st.

G.I.P. RAILWAY—2000-TON TRAIN FITTED THROUGHOUT WITH THE A.V. BRAKE



REAR VIEW OF 2000-TON TRAIN, SHOWING 10-TON VAN

LOCOMOTIVE COUNTERBALANCING, &c.

SIR,—With reference to Mr. F. W. Brewer's letter on this subject in last week's THE ENGINEER, I should very much like to know what evidence exists to show that the Agenoria originally had cast iron wheels.

I question whether either the Stourbridge Lion or Agenoria had domes when they were constructed, in 1828 and 1829. Agenoria now has a dome on the rear end of the barrel, but a close examination of the engine leads me to think that it was, like the balance weights, a later addition.

The boiler, cylinders and some other parts of the Stourbridge Lion still exist, and are in the National Museum at Washington. These parts are almost identical with those of the Agenoria. There is no large opening on top of the boiler, except a manhole on the middle ring, neither is there an opening behind the chimney in the position occupied by the small dome in the drawing of the Lion published in THE ENGINEER in March, 1890.

Some of Stephenson's engines which opened the Liverpool and Manchester Railway in 1830 had domes.

Wembley, May 5th. E. A. FORWARD.

ENGINEERING GOLFING SOCIETY.—The spring meeting of the Engineering Golfing Society was held on the West Hill Links, Brookwood, on Wednesday, the 10th inst. Results:—Morning, 18-hole medal round: First division (handicaps of 10 and under), President's Cup and Memento were won by Mr. A. J. Boyd with a score of 80 net.; the second prize was won by Mr. F. R. Phipps, with 91 — 9 = 82. Second division (handicaps of 11 and over), the Wilson Cup and Memento were won by Mr. F. Bolton, with 92 — 14 = 78; the second prize being taken by Mr. W. L. Mansergh, with a score of 90 — 11 = 79; scratch prize, presented by the Captain (Mr. K. A. Wolfe Barry) was won by Mr. A. J. Boyd, 80. In the afternoon four-ball foursomes, the first prizes were won by Messrs. A. P. Livesey and H. P. Allison, 6 up; for the second prizes there was a triple tie between Messrs. R. S. Tobey and L. Trewby, A. F. Holden and Arthur Valon, and C. S. Davidson and H. E. Midgley, who were all all square. These ties will be played off in due course. There were fifty-five competitors, and the meeting was successful in every way.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—The annual general meeting of the Institution of Electrical Engineers—corporate members and associates only—will be held on Thursday, May 25th, 1922, at 6 p.m., at the Institution Building, Savoy-place, Victoria Embankment, W.C. 2, to receive and consider the accounts for the year ended December 31st, 1921, and the annual report of the Council, and to elect auditors. The annual conversazione will be held on Thursday, June 29th, 1922, 8.30 to 11 p.m., at the Natural History Museum, S.W.

ELECTRICITY AND AGRICULTURE.—Under the auspices of the Institution of Electrical Engineers and in conjunction with the Dublin May Agricultural Show, Mr. R. Borlase Matthews, M.I.E.E., is to repeat the paper which he read recently in London. This lecture will be given at 8 p.m. on May 16th, at Leinster House, Kildare-street, Dublin. The title of this paper is "Electro-farming, or the Applications of Electricity to Agriculture." It will be illustrated by the cinematograph and slides.

A Seven-Day Journal.

Alcohol as a Motor Fuel.

THE interim report issued by Dr. Ormandy's Sub-committee of the Empire Motor Fuels Committee, of which the substance is given elsewhere in this issue, contains highly important information relating to the use of alcohol as a fuel for internal combustion engines. Using a very pure alcohol, the Committee obtained from a Ricardo variable compression engine results which in most particulars excelled those obtainable by using petrol or benzol as the fuel. Not only was the thermal efficiency higher, but the compression pressure could be varied over a much wider range without incurring pre-ignition or detonation, while at no piston speed at which the test engine was run was the rate of combustion too slow to obtain the maximum effect. It would appear, too, that the presence of water in the fuel up to the extent of 10 per cent. by volume is actually advantageous, particularly in engines having very high compression pressures. If alcohol becomes a practical motor fuel, it is probable that at first it will be used in admixture with some other substance, such as petrol, benzol or paraffin. This aspect of the subject is now being studied by the Sub-committee, and a report, it is understood, may shortly be expected on mixtures of alcohol and ether.

Proposed Dock Extension at Workington.

THE announcement has been made that under the Trade Facilities Act the Government is willing to lend the Workington Harbour and Dock Board the sum of £500,000 for the purpose of enlarging the existing dock facilities at the port. The completion of the scheme would make Workington, with its readily available supplies of iron ore, coal, coke and limestone, one of the most self-contained centres of the iron and steel industry in the kingdom. The engineers for the scheme are Messrs. Rendel, Palmer and Tritton, of London. Accommodation will be provided in the enlarged dock for vessels up to 12,000 tons. It is expected that the work will be completed in about two years' time.

The Late Mr. Alexander Cleghorn.

BY the sudden death on the 4th inst. of Mr. Alexander Cleghorn, marine engineering circles in Glasgow and the country generally have lost an outstanding and popular member. Mr. Cleghorn was born in Fifeshire about sixty-three years ago, and after receiving his elementary education at St. Andrews, studied engineering and naval architecture at Edinburgh and Glasgow Universities. He served his apprenticeship with Robert Napier and Sons, of Govan, and with that firm became in succession leading draughtsman, works manager and assistant manager. From 1897 to 1905 he occupied the post of engineering manager to Barclay, Curle and Co., Limited, of Whiteinch. In the last-named year he entered the service of the Fairfield Company in a similar capacity. Subsequently he was elected a director of the company. He retired from active work in 1920. Mr. Cleghorn was a member of the Institution of Civil Engineers, a member of Council of the Institution of Naval Architects, and a member of Council and Past-president of the Institution of Engineers and Shipbuilders in Scotland.

The Private Use of the National Dockyards.

THE suggestion that the national dockyards should be partially placed at the disposal of private shipbuilders has been definitely rejected by the Admiralty on the ground that such a scheme would have no likelihood of meeting with commercial success in any of the establishments. It is pointed out that the yards cannot be divided into two distinct sections without entailing considerable expense. This remark applies particularly to the power and supply services. It is feared, too, that a commercial firm would require a priority in the matter of facilities for executing its work which the Navy could not always afford to give. Considerable alterations and additions would, further, be necessary in the shops. The leasing of part of the yard at Chatham to a private firm would, for instance, entail an immediate expenditure estimated at £13,000. Finally, it is held that the disparity of wages and conditions of employment between the men engaged in the naval section and those in the private portion would prove a fruitful source of discontent.

The Gretna Factory.

A REPORT is again current that the Gretna munitions factory is about to be sold in one lot to a syndicate, which proposes to establish industries and develop the area to its utmost extent. The factory covers an area of land some 12 miles in length. Its erection was begun in 1915 and cost several millions of pounds. At the Armistice it was employing about 25,000 people. The negotiations between the syndicate and the Disposals Board would appear to have reached something in the nature of a deadlock, as a result of the Board's insistence upon holding to its own valuation of the property, as opposed to the syndicate's view that it should be valued by neutral valuers. As the syndicate's offer, if accepted, would result in the immediate employment of a large number of people, the communities in the neighbourhood of the factory are taking steps to induce the Government to alter its decision.

Developments at a Nottingham Factory.

A LARGE new extension of the Raleigh Cycle Works at Nottingham was opened last Friday. In the course of some remarks made at a luncheon given to celebrate the occasion, Sir Harold Bowden, the managing director and a son of the founder of the firm, said that the works had now an annual capacity for 100,000 cycles, 10,000 motor cars and about 250,000 three-speed gears. The firm had found that the Germans, because of the low rate of exchange, could place bicycles on the British market at a price that was less than the cost of production in this country. The company's workpeople, in view of this fact, had consented to a reduction in wages, and the company had, in keeping with that sacrifice, agreed to make a 50 per cent. reduction in its profits. With the assistance thus afforded, he hoped they would soon be able to work up towards their capacity, provided something were done to stabilise the foreign rates of exchange.

The Grampian Electricity Supply Scheme.

THE Bill dealing with the Grampian hydro-electric scheme has now been passed through Committee, and is ready for presentation to the House of Commons for third reading. Under this scheme, the Hydro-electric Development Company proposes to tap the water power available within an area covering about 417 square miles in the northern portion of Perthshire adjoining the eastern boundary of the area serving the Lochaber scheme. The power developed would amount to some 56,000 continuous horse-power, and would be available for the whole of Central Scotland. There would be four power-houses, one on the river Tummel—17,400 horse-power—one at the western end of Loch Rannoch—26,900 horse-power—one on the river Garry—7500 horse-power—and one on the Bruar water—4200 horse-power. One of the chief works would consist of raising the level of Loch Ericht by 37ft. by diverting into it through a tunnel the waters of Loch Garry. From the southern end of Loch Ericht a tunnel would carry the water to the power-house on Loch Rannoch. The electrification of the Highland Railway would probably be a prominent outcome of the scheme. If the Bill is duly passed by Parliament, the bulk of the work, it is estimated, would be well on towards completion in three years' time. The total cost of carrying out the scheme is estimated at £4,500,000.

Oil Boring in Scotland.

UNDER the Government scheme for prospecting for oil in this country, two borings were made in Scotland, in addition to the Derbyshire one. The boring at West Calder was abandoned some time ago. That near Dalkeith has now been reported to have reached oil sand at a depth of about 1810ft. The prospects of a considerable yield are said to be good. Messrs. Pearson are in charge of the operations.

Government Aid for the Cornish Tin Mines.

CONFIRMATION is forthcoming of the report that the Government, under the Trade Facilities Act, intends to afford some measure of assistance to the Cornish tin-mining industry. For a long time past the industry has been in a very precarious condition, and much unemployment and distress have been experienced by the miners. The Government was repeatedly pressed to extend some help, but always opposed anything in the nature of a subsidy, on the ground that it was doubtful whether such assistance would fulfil the object of re-establishing the prosperity of the industry. It has now decided, however, to guarantee the loan to the South Crofty Mine of £30,000, partly, it is presumed, to help towards the installation of additional pumping machinery. It is possible that similar assistance will be afforded to the Dolcoath, Levant, and certain other mines.

Wireless Telephony Developments.

IN the course of his statement in Parliament on the Post Office Vote, Mr. Kellaway revealed in outline his proposals for facilitating the popular use of wireless telephony. In order to avoid the chaos which, he said, had resulted in the United States from the unrestricted establishment of private transmitting stations, he proposed that only firms actually manufacturing wireless apparatus should be allowed to do the broadcasting, and that the broadcasting stations should be strictly limited in number. One or more broadcasting stations would be allowed in the areas centering round London, Cardiff, Plymouth, Birmingham, Manchester, Newcastle, Glasgow—or Edinburgh—and Aberdeen. The stations would be limited to a power of 1½ kilowatts, and would use wave lengths that would not interfere with other wireless services. The broadcasting would be permitted only between 5 p.m. and 11 p.m. on weekdays, but there would be no time limit on Sundays. The Marconi Company, it may be added, is already making preparations to supply a large number of receiving sets to private individuals.

Experiments on H.M.S. Superb.

As a result of experiences at the battle of Jutland and on other occasions, it was established that British warships were more liable than German to magazine fires caused by the passage of flame down the trunks between the turrets and the ammunition rooms. To devise means to prevent such flashing, while not impeding the free passage upwards of the ammunition, is not an easy task. Numerous proposals to meet the requirement have, however, been submitted to the Admiralty, and certain of them are now being tested on the old battleship Superb at Portsmouth. There is no intention of sinking the vessel in the course of the experiments. Light guns only are being used with a small amount of loose cordite at the foot of the ammunition trunk, so that any explosion that may be caused will not be sufficient seriously to damage the vessel.

The Engineering Lock-out.

THE dispute in the engineering industry has taken no turn for the better. Sir William Mackenzie's court of inquiry, after an interruption last Friday, during which an effort was made to reopen direct negotiations between the employers and the unions, came to its conclusion on Saturday. The report of its findings was published on Wednesday evening. A statement of Sir William's conclusions will be found elsewhere in this issue. In his third paragraph, it will be noticed, he leans towards the employers' view that in the event of a proposed material change in the workshop conditions being made the subject of discussion, the management may put it into force pending a decision on the point in question, any agreement subsequently arrived at having, where appropriate, retrospective effect. The union representatives, it will be remembered, have all along held that a proposed change should not be put into force until final agreement had been reached. The paragraph in the report to which most attention, we imagine, will be directed is, however, the fourth, for it seems to foreshadow the acceptance by the employers of a new principle, namely, that skilled workers displaced by the adoption of new machinery or methods are to be found corresponding skilled work in another direction. From the engineering centres the latest reports to hand indicate that the number of unionists who have resumed work on the "individual contract" terms offered them by the employers is small. It is, however, somewhat difficult to arrive at the truth of the matter. Certain it is that some firms have found it quite possible to keep their works going with the labour available.

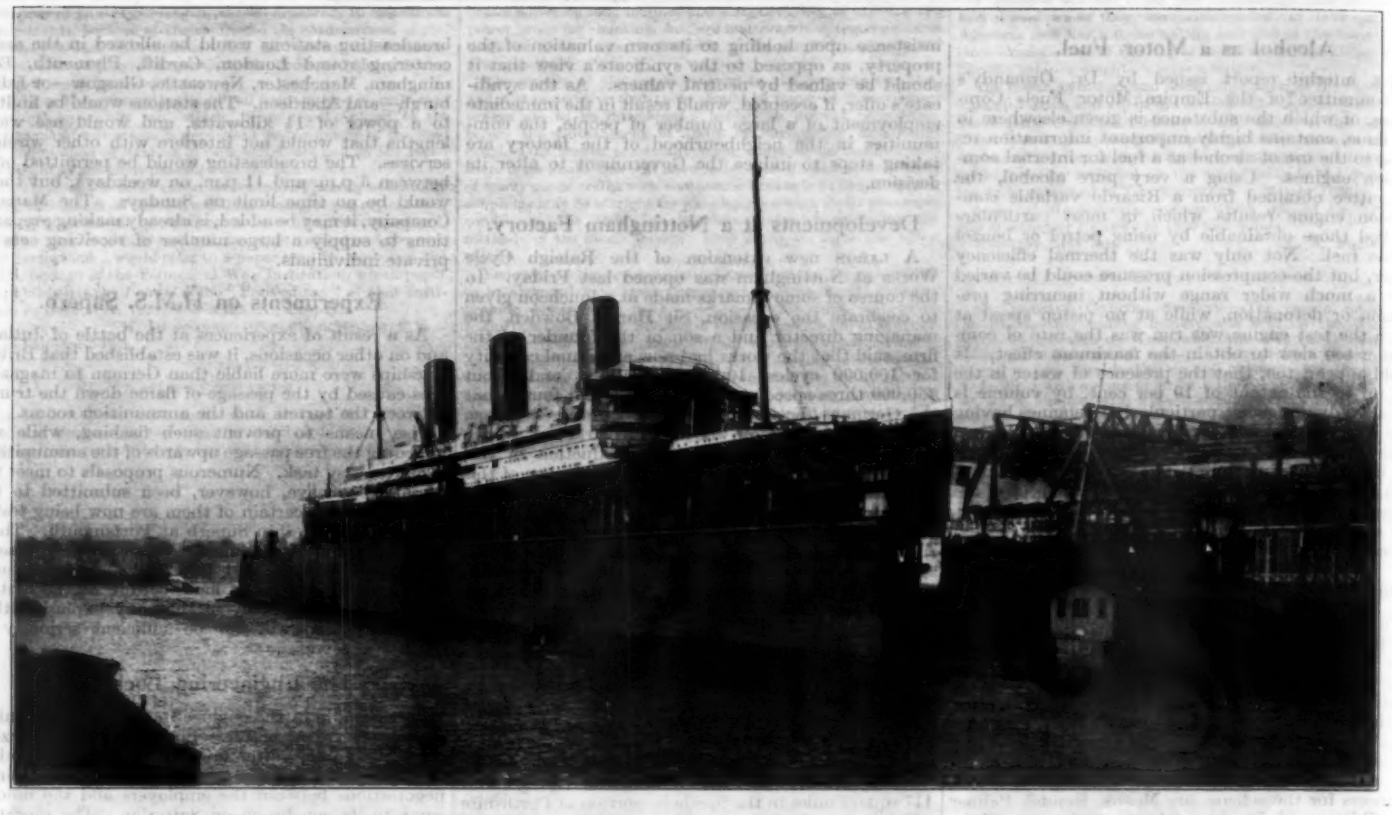
The G.W.R. and Swansea Harbour.

UNOFFICIAL negotiations, it is stated, are at present being conducted between the Great Western Railway Company and the Swansea Harbour Trust with a view to the entrance of the Swansea Harbour undertaking into the Western railway group. Should the arrangement be made, as, it is believed, there is every probability that it will, the railway group will control all the docks and harbours in the Bristol Channel as far west as Fishguard.

Settlement of the Shipyard Dispute.

THE result of the ballot of the members of the Engineering and Shipbuilding Trades' Federation, the General Workers' Union and the National Union of Labour, in connection with the strike in the shipbuilding industry over the proposed reduction of 16s. 6d. per week in the war bonus, showed a vote of 46,306 against and 41,264 in favour of accepting the terms arranged between the employers and the unions' negotiating committee. The majority of 5042 against acceptance fell far short of the two-thirds proportion stated to be required to authorise the continuation of the strike, and as a consequence the men were instructed to resume work on Monday morning. At the majority of the yards the order was obeyed without demur, although not all the men applying to be taken on again could be engaged by reason of the shortage of work. At Barrow and on the Mersey trouble was experienced from the fact that the men were dissatisfied with the national award. The boilermakers in the latter district refuse to recognise the two-thirds majority rule, and in conjunction with other shipyard workers are remaining out.

THE WHITE STAR LINER MAJESTIC IN FLOATING DOCK AT HAMBURG



The White Star Liner Majestic.

ON the arrival of the Mauretania at Southampton on the first of the month, after her record run, the harbour presented an unusual and interesting spectacle, for there were berthed in it at that time no less than four of the world's largest passenger ships. The Cunard Line was represented by the Mauretania, 30,000 tons, and the Berengaria—formerly the German Imperator—of 52,000 tons, while the other two were White Star liners, the Olympic, 46,000 tons, and the Majestic, 56,000 tons. The Majestic is of special interest, not only because she is the largest liner afloat, but also on account of her association with the pre-war competition for size and speed in Transatlantic liners to which she owes her conception. With the altered economic position and the present high constructional costs, it is very likely she will continue to retain her distinctive position for some time to come.

Originally built to the order of the Hamburg-Amerika Line at the Elbe shipyard of Blohm and Voss, Hamburg, and christened the Bismarck, work on her was well in hand when the outbreak of war came, and was continued till about the middle of 1916. After that time little progress was made, and about that period all copper pipes were removed and replaced by pipes of steel, which have for the most part been retained.

By the Versailles Treaty it was provided that vessels under construction should be completed by the Germans as designed and handed over to the Reparations Commission. Some twenty-five ships were allotted to this country, representing a gross tonnage of 255,000 tons, of which the Bismarck was one, and all of these vessels, except one of 18,000 tons, have now been delivered. The White Star Line purchased the Bismarck from the Reparations Commission, and, re-naming her the Majestic, began nearly a year ago to supervise her completion, and at the same time introduced such modifications as were necessary to bring her into line with the standard White Star practice. This work was carried out under the direct supervision of a special staff of Harland and Wolff and White Star engineers and naval architects, at a cost of about three-quarters of a million pounds, and we understand that the builders gave uniform courtesy and assistance.

GENERAL PARTICULARS.

The Majestic has an overall length of 956ft., and is 100ft. broad, with a gross tonnage of over 56,000 tons, and a displacement of 64,000 tons when loaded to her marks. Her height from keel to boat deck is 102ft., and the look-out man in the crow's nest is perched 180ft. above the water line. Her sister ship the President Harding—launched as the Vaterland and afterwards named the Leviathan—is a little shorter and slightly broader, with a less measurement of some 2000 tons. The President Harding is now being reconditioned by the United States Shipping Board. A special feature in the design of the Majestic is the arrangement of her decks. Above the five steel decks, which run from end to end of the ship, there are four steel-plated erection decks which cover at least half her length. The boiler casings, instead of passing up the centre of the vessel, are divided and placed towards the sides of the ship, and are then carried up above the top deck, where they unite to form a centre superstructure for the funnels. This method, which is adopted for two of the funnels—the third being a dummy funnel—permits of better ventilation for the boiler-rooms, and from an architectural point of view admits of great breadth in the disposition and size of the cabins and public rooms throughout the seven decks on which most of the first-class passenger accommodation is provided. The main entrance is situated almost amidships, and, in addition to electric elevators, two main staircases, one on each side of the ship, rise from deck F to deck A. The vestibule is very lofty, and permits a free view into the dining saloon, which room has a total area of 11,350 square feet and a height of 31ft. at the centre of the middle part, the sides being supported by wide-spaced Ionic pillars. The vestibule is repeated throughout the five decks, and a broad central passage, on each side of which are grouped the state rooms and cabins, leads to the other first-class staircase, which is situated in the forward part of the accommodation. The main staircase ends on the level of the large vestibule between the lounge and palm court, 11ft. above the promenade deck, and gives access to the wireless station and gymnasium. The rooms on deck B deserve particular mention. The lounge is entered through an arch formed by the two casings leading to the second funnel, and there is a clear and uninterrupted view for 250ft. from the stage in the lounge at the forward end through the main entrance to the palm court and the raised restaurant at its after end.

Other rooms we may briefly refer to are the reading and writing rooms, the library and the well-proportioned smoking-room, from which, through large curved glass windows, an excellent view over the bow and the sides of the ship is obtained. One of the features on the vessel is a swimming bath, which is placed forward of the main entrance on deck E. The basin has an area of 820 square feet, and may be filled with 120 tons of warm sea water in about twenty-five minutes. We give on the opposite page some views of various rooms in the ship.

The Majestic has a full complement of over 5000 persons, this number including 850 first-class passengers, 545 second-class passengers, and 2392 third-class passengers, with a crew of over 1100.

MACHINERY.

The Majestic is driven by four four-bladed propellers, each with a one-piece boss, made by the Manganese Bronze Company, Limited, of London. The propelling machinery consists of quadruple turbines of the combined impulse and reaction type, Curtis wheels being fitted before the Parsons drums. The turbines are arranged in two engine-rooms on the port and starboard. The steam enters the high-pressure turbine on the port inner shaft, and passes on to the intermediate-pressure turbine on the starboard inner shaft, from where, equally divided, it again passes to the two low-pressure turbines on the outer shafts. Each separate shaft, however, is available for running or manœuvring by itself, but under ordinary working conditions the two low-pressure turbines operate in parallel. The total ahead horse-power is 66,000, and the astern power 36,000. According to contract, the vessel should travel at a speed of 23 knots when loaded to a mean draught corresponding to a departure draught of 35ft. 6in., and when the turbines are developing 66,000 shaft horse-power at a speed of 180 revolutions per minute, with a boiler pressure of 235 lb. per square inch. Actually on her run from Cuxhaven to Southampton she developed over 70,000 horse-power and a speed of 25 knots was reached. The astern turbines are subdivided into high-pressure and low-pressure turbines, and the low-pressure turbines are again placed on the outer shafts. By-pass valves are provided whereby high-pressure steam may be supplied to the other turbines, should at any time excess steam warrant this procedure. Thrust blocks of the ordinary pattern are provided. The turbines exhaust into pear-shaped condensers, and Weir's dual air pumps are installed. The turbine controls are all worked from a special control station placed above the engine-rooms, and all the main valves are hydraulically operated and electrically controlled. The boiler installation consists of forty-eight water-tube boilers of the Yarrow-Normand type, which are fitted with oil burners working on the White low-pressure system, and the boilers are accommodated in four boiler-rooms. They are designed for a working pressure of 250 lb. per square inch, and were tested to nearly double that pressure. The combined heating surface is over 219,000 square feet, and the total grate area exceeds 4000 square feet. We noted with interest that the boilers were fitted throughout with Mumford's patent automatic feed controls. Aft of the main engine-room is an outer engine-room, containing five A.E.G. turbo-generating sets, each having an output of 280 kilowatts. A large central switchboard is provided, from which the lighting and power requirements of the ship may be controlled. Current is supplied to over 15,000 electric lamps, in addition to various motors. On E deck a special 70-kilowatt oil-driven emergency dynamo is installed, which is of the Diesel type. This machine is driven by an A.E.G. two-stroke cycle opposed-piston type engine, with two vertical cylinders, which, along with its generator, is completely enclosed. The emergency set supplies current for the lighting and wireless installations, and also provides power for the six 20 horse-power motors which operate the Welin boat-handling gear.

ELECTRICAL AND GENERAL EQUIPMENT.

The system of telegraphs and telephones installed throughout the ship is very complete. Among the

former may be mentioned the engine telegraphs, the starting telegraphs and rudder tell-tale, also the docking and anchor telegraphs, the boiler-room telegraphs and the distant revolution telegraph. A loud-speaking telephone system is installed for operating the ship and for communication between the engine and boiler rooms, and this system is so arranged that any boiler-room can speak to any other boiler-room or to the engine-rooms and the engineers' department. Communication between the look-out man in the crow's nest and the bridge is established by a loud-speaking telephone, in addition to the ordinary telephone. The ordinary telephone system for executive and departmental use has its own central exchange, which may be connected to shore when the vessel is berthed.

There are three wireless stations, and the largest is capable of maintaining permanent connection with both continents during the whole of the voyage. A smaller station is used for communication over a distance of 800 miles, and a subsidiary one is reserved for use in case of an emergency. In addition to the usual signalling arrangements, special provision has been made to guarantee as far as possible the safe navigation of the vessel in fog. Submarine signalling gear has been installed, and the Willett Bruce electric fog bell and whistle fitted. The fire alarm system includes some 450 fire alarms, distributed throughout the ship, which automatically indicate to the officer on watch when the temperature in any compartment has been exceeded. This system is centralised on the navigation bridge, and is combined with a smoke-detection device, consisting of lines of tubing through which air may be drawn. Other signals which are shown on the navigating bridge are the water-tight door indicators and the cooling-room door telltales. Electric clocks are fitted throughout the vessel. Every precaution has been taken to reduce as far as humanly possible dangers which might arise in case of fire or collision, and an ample complement of life-boats are carried, including two motor lifeboats fitted with wireless. All boats are swung out and lowered on the Welin system, which, as previously mentioned, is electrically operated. A somewhat novel fitting is the Fram night lifebuoy, which may be instantly released from the bridge by electrical means. Fram anti-rolling tanks are also fitted in addition to the usual bilge keels.

From what has been said, it will be appreciated that the Majestic is a vessel which reflects credit on her builders, those who have supervised her completion, and the flag under which she sails. Her maiden voyage began on Wednesday last, when she left Southampton for New York under the command of Commodore Sir Bertram Hayes. Before her departure, the White Star Line—her owners—provided an opportunity of inspecting her. In welcoming the guests present on that occasion, Mr. Harold Sanderson, the chairman of the company, made the interesting announcement that a provisional agreement had been made with the London and South-Western Railway, whereby they hoped that within the next twelve months a suitable floating dock would be provided for this vessel at Southampton. Our illustration shows the ship in the floating dock at the builder's yard on the Elbe.

THE LOUNGE, LOOKING TOWARDS ENTRANCE

PALM COURT

FIRST-CLASS DINING SALOON

THE SWIMMING BATH

Institution of Chemical Engineers.

At a largely attended inaugural meeting and dinner at the Hotel Cecil, London, under the chairmanship of Sir Arthur Duckham, on Tuesday, May 2nd, the Institution of Chemical Engineers came into being. As a matter of fact, the Provisional Committee which was appointed at the meeting last year had got so far as to give instructions to the solicitors to proceed to register the Institution as a "company limited by guarantee and not having capital divided by shares," and articles of association and by-laws have been drawn up. This action on the part of the Provisional Committee was approved by the meeting, and it is intended to hold another meeting in the autumn to report the further progress made meanwhile. Among those present, in addition to Sir Arthur Duckham, were Sir Frederick Nathan, Professor J. W. Hinchley, Mr. H. Talbot, Mr. F. Rogers, Mr. J. A. Reavell, Mr. C. S. Garland, Dr. F. H. Carr, Dr. Seligman, Mr. W. J. U. Woolcock, Dr. W. R. Ormandy, Mr. E. A. Alliott, Mr. P. Parrish, Mr. W. W. Townsend, Mr. B. T. Brooks (U.S.A.), Mr. A. J. Broughall, and Dr. H. J. Bush.

Professor J. W. Hinchley, who has acted as honorary secretary of the Institution since its inception, then presented a report upon the work done since the Provisional Committee was appointed at the meeting held on November 9th, 1921. The Committee met nine times, and agreed that "The Institution of Chemical Engineers be incorporated as a limited liability company, limited by guarantee, with the omission of the word 'limited,' the permission for such omission being obtained from the Board of Trade." It was also agreed that a clause be inserted in the constitution referring to the future application for a Royal Charter. The Institution, added Professor Hinchley, intends to encourage and help to create a new kind of professional man—the chemical engineer—and it will devote all its energies to producing and maintaining a high standard of educational, technical and professional attainments.

Mr. F. H. Rogers, hon. treasurer, reporting upon the financial position, said that donations were still coming in very generously, and up to the present £1425 had been guaranteed. The cash received amounted to £606, and the disbursements had been £433.

The Chairman said the Committee had not feared to go ahead, having regard to the amount of support that had been received, while the letters that had come to hand showed the necessity for such an Institution. He knew from his own experience the absolute necessity for combining the engineer and the chemist in the person of the chemical engineer. He had known chemists who had put forward ideas which were absolutely impossible from the engineering point of view, and engineers who had put forward ideas which were entirely against all chemical possibilities. America had gone ahead of us in that matter, and this country must take it up and push it for all it was worth. There was one very important point with regard to the Institution which he had mentioned when he first addressed them in November. He then made it clear that he was against a multitude of institutions, and he hoped that theirs would be the last; indeed, he hoped that the initiation of that Institution would see some form of amalgamation of institutions so far as the holding of meetings was concerned. The overlapping of the work of institutions in that respect was to be deprecated, and he hoped the work of forming the new Institution would lead to a union of institutions. The new Institution was really the half-way house between quite a lot of institutions. There were the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institute of Chemistry, and the Society of Chemical Industry, and if they looked at the matter, they would see that the Institution of Chemical Engineers would be the society which brought all those other bodies together in the work of the chemical engineer, because every engineer had to have some knowledge of chemistry, and every chemist—except, perhaps, the purely research chemist—had to have some knowledge of engineering.

Mr. W. J. U. Woolcock, speaking with regard to the by-laws which had been drawn up, explained that the entrance fee to the Institution had been fixed at five guineas for full members, three guineas for associate

members, one guinea for graduates, and half a guinea for students. The subscriptions were five guineas, three guineas, two guineas and half a guinea respectively, and a student over the age of twenty-one would pay one guinea. There were proportionate reductions to members living outside the United Kingdom.

A Sleeper Creosoting Plant.

In East Africa, as in many other newly developed countries, the railways were primarily laid on rough-hewn and untreated sleepers. No great thought has been given to the deterioration of the wood with age, as there were then ample supplies of native timber close to the lines and the replacement of worn sleepers was not a serious matter, as compared with the desirability of opening up communications. But in Kenya—formerly British East Africa—such inroads have been made into the more accessible forests, not only for sleepers, but also for firewood, that things have come to the pass that fuel has to be imported for the locomotives. In these circumstances, timber sleepers must naturally be economised as far as possible, and it has been decided to adopt creosoting as a preservative. The authorities have therefore ordered from Burt, Boulton and Haywood, Limited, Silvertown, the creosoting plant shown in the engravings on this and on page 526, which we recently inspected as it was erected and tested previous to shipment.

In ordinary soils in the temperate zone untreated fir timber generally becomes useless in about three years in the parts just above and below the ground. On land the chief enemy appears to be dry rot, caused by the fungus *merulius lachrymans*, whilst in salt water the boring mollusc *teredo navalis* and the crustacean *limnoria terebrans* are the greatest destroyers. In warmer climates there are, in addition to fungi, several insect enemies, the worst of which is probably the termite or white ant.

There are many substances which are said to prevent the attacks of these parasites, but there are only one or two which are practically successful. In the first place, the preservative must be reasonably cheap, and, in the second place, it must stay and remain active in the timber.

Creosote has proved to be a readily available product which really acts as a safeguard against decay. It is highly antiseptic, but it is not only its antiseptic properties that are important; it gives greatly prolonged mechanical life to timber, enabling it to resist the stresses consequent on changes of weather and those of actual wear and tear in use.

The plant under review, which has been designed by the company's works engineer, Mr. W. R. Sergeant, is arranged to operate either Rueping, Lowry or full cell processes, and comprises two large receptacles, one above the other, of which the lower one is the working cylinder, together with the necessary pumps and boiler. The capacity is 900 metre-gauge sleepers per day of eight hours.

The cylinder is 36ft. long by 6ft. 6in. diameter, and it is capable of withstanding working pressure of 200 lb. per square inch. The top container is connected with the creosoting cylinder by 8in. diameter pipes, by means of which the charge of creosote can be transferred from one cylinder to the other in eight minutes. The air compressor is of the feather valve type, and is also used as a vacuum pump for the Rueping and Lowry processes, when a vacuum of 26in. is reached in twenty minutes. The creosote pressure pump is an outside centre packed ram pump, and is arranged for general service, having suctions from the tank wagon sump, drip tanks and the creosoting cylinder, while there are deliveries to the storage tank and top container as well as to the creosoting cylinder. The boiler has a large grate area for burning wood waste as fuel, and has two sets of water gauges, a feed pump and an injector.

The mode of operating the plant naturally depends upon the process adopted. The Rueping process, which seems to be admirably suited for service abroad, consists of first compressing air in the cylinder to about 60 lb. per square inch. At the same time, a similar pressure is maintained in the container. Then, while the air pressure is still on, the charge of creosote is transferred by gravity from the container to the cylinder. After the cylinder is full, more creosote is forced in by the pressure pump until the desired amount has been pressed into the timber, usually 10 lb. per cubic foot. During this process, the pressure will have risen to between 75 lb. and 150 lb. per square inch, according to the nature of the timber being treated. The pressure is then released, the creosote is transferred to the top cylinder and a vacuum applied by the air pump. On first releasing the pressure, the compressed air imprisoned in the timber expands and expels a large quantity of the creosote from the cells of the wood; the vacuum removes some more. While the internal cells of the timber do not retain the full plugging of creosote, they have received a coating of preservative, and it is possible to save at least 50 per cent. of the oil which would be lost if the cells were left full.

The Lowry process is carried out as follows:—The timber is placed in the creosoting cylinder, creosote is pumped in under pressure, and the pressure maintained until the desired penetration has been effected. The oil is then pumped away and a vacuum applied to the cylinder until the excess creosote has been removed. This and analogous processes are largely used by the main railways of the United States and Canada.

By the full cell process—originally known as the Bethell process—seasoned timber is fully impregnated with creosote by first exhausting air from the timber in the closed cylinder containing the timber, filling up the cylinder with hot creosote from the overhead container, forcing the creosote in by pressure until absorption is complete, and then emptying the cylinder and removing the timber fully charged with creosote.

In climates where it has been found impossible to season timber by the ordinary methods, the Boulton process can be operated on this plant by the addition of a condenser and receiver. With this process, green unseasoned timber is immersed in a cylinder charged with hot creosote oil and a vacuum applied. As the pressure falls, the oil must always be kept at a temperature above that at which the water boils. The water vapour is condensed in the condenser placed between the creosoting cylinder and the vacuum pump. The temperature required is considerably below that at which timber is injured, and as the latter is immersed in oil throughout the process, there is no tendency for it to shake. As and when the water is removed, more oil is pumped in, and finally pressure is applied until the desired impregnation is reached. The cylinder is then emptied and the charge removed.

The head office of the makers of this plant is at Salisbury House, London-wall, E.C. 2.

CHARGE OF SLEEPERS ABOUT TO ENTER WORKING CYLINDER

The Engineering Dispute.

On Wednesday evening Sir William Mackenzie laid on the table of the House of Commons the report of his Court of Inquiry on the dispute in the engineering trades. On the question of overtime the report says:—"The question of necessity in regard to overtime is related to the requirements of the work to be done and the business in hand, and as to this necessity the management alone are in a position to judge. The national agreement of September, 1920, allowing thirty hours in four weeks, implies that, up to that limit, overtime, granted its necessity, is regarded as reasonable. Up to that limit there must be freedom to the management to act in the exercise of their discretion. Beyond that limit overtime would be open to the suggestion that it is unreasonable. The general limit of thirty hours is, of course, subject to further discussion; and if experience shows that the deterrent economic effect of the rate of time and a half is inadequate to prevent unnecessary overtime, there is a case for further negotiation with a view to a revised national agreement."

On the question of managerial functions the report says:—

"(*a*) The employers contend that if British engineering is to maintain its appropriate place in the forefront of the industries of the world there must be freedom to the management to introduce such changes into the works as may be necessary for the proper development of the industry. There are general agreements between the national organisations of the employers and the trade unions settling many of the conditions of employment in the industry and providing detailed machinery for the discussion of matters arising between employers and employed. It is understood that the employers are willing that the kind of question which has been under discussion during the present dispute should be settled by general national agreement, or determined in accordance with procedure set up by such agreements. This is a view to which the unions do not take exception.

"(*b*) In the ordinary course, a projected workshop change would be more or less common knowledge in the shop for some time before the proposed change was made, but information as to a proposed change in the recognised working conditions should be given to the workpeople directly concerned or their representatives in the shop, and in order that there may be time for discussion, if discussion is desired, the information should be available to the workpeople directly concerned or their representatives in the shop a limited period before it is proposed that the change should be made.

"(*c*) The opportunity for prior consultation between the management and the men directly concerned, or their representatives in the shop, upon proposed changes in the recognised working conditions should be adequate, but should not involve undue delay. If consultation during the limited period mentioned in the last paragraph does not result in an agreement the further stages of the provisions for avoiding disputes should follow; but in the meantime the management may, if they think it necessary and in the exercise of their discretion, put the change into operation, any subsequent agreement that may be reached upon the case having retrospective effect where appropriate. In the case of those unions which have not yet any provisions for avoiding disputes a simple procedure should in the meantime be adopted to deal with changes in the shop.

"(*d*) It is evident that the opposition to change on the part of the skilled men is due largely to the uncertainty which the members of the unions feel as to their position if they are displaced as a result of the change. An expanding industry like the engineering trade is capable of making readjustments affecting particular classes of workpeople, while at the same time providing for the proper utilisation of the skill thus set free. An agreement to the principle of making such arrangements as shall provide avenues of employment for such men ought not to be difficult; and as the success of any change depends largely on its willing acceptance by the men, the measure of such acceptance will depend on the action of the employers, in conjunction with the union, in accommodating in skilled employment the men set free. It will, of course, be understood that the changes referred to, which are the subject of difference between the parties, are not changes in such matters as wages and hours, which are determined on a national basis."

Sir William Mackenzie, summarising the whole matter, gives it as his opinion that it is "one in which no agreement, however carefully devised, can wholly take the place of good sense and good will between the parties, and an appreciation by either side of the difficulties and point of view of the other. The managing of a business is a responsible and difficult task, and no individual workman or trade union official should unnecessarily or without good cause add to its anxieties. Similarly, each employer, and those acting under him, should recognise that, in his more restricted sphere, the workman is conscious that issues are sometimes at stake which are of the utmost importance to him and upon which consultation and, as far as possible, accommodation may be the wisest as well as the most humane policy."

ELECTRICAL SUPPLIES IN LATIN-AMERICA.

Northern Argentina at the present time is offering a broadening market for small electrical plants, such as can be adapted to the requirements of churches, small cinema establishments, country clubs, hospitals, dairies, engineering construction works and various industrial plants upon small and large estates. Similar installations are becoming popular for municipal lighting in towns too small to establish a general power plant, while summer resorts and country hotels are likewise probable purchasers. In the Rosario district, a great part of the electrical installations and supplies is in the hands of a British company. Twelve varieties of lighting installations have been introduced, and over 1700 of one variety alone sold. The Rosario district is large, and it is dependent to a great extent upon small plants, in view of the high cost of fuel and the great distances between towns, when render power transmission costly.

Farming operations in Argentina are carried on from one central group of buildings or several groups, in which extensive industrial operations, such as dairying, milling, tanning, &c., can be conducted by means of electrical power transmission. The farms vary in size from about 600 to over 35,000 acres. Of the smaller-sized farms, the Rosario district has a considerable number, it being estimated that the province of Santa Fé—of which Rosario is the capital and port—and that of Córdaba adjoining, contain a total of 81,330 farms. There is already a substantial demand for an installation employing either petrol of paraffin, furnishing from forty to seventy lights of 16 candle-power each, or 4 kilowatts for cinema establishments. British electrical installations have become popular because of their economy of working. It is claimed that the lighting of an ordinary country dwelling may be obtained at less than 4s. 6d. per week. Recently a public exhibition was given of a lighting unit using a storage battery, the latter maintaining forty lamps at the same time that the uncoupled motor was used to operate dairy machinery.

The market is already being courted by German firms. A new lighting unit, provided with a German gas engine, has been recently introduced by the Siemens-Schuckert Company. Manufacturers who propose to compete should remember that small lighting installations must be economical in first cost as well as in operation, and worked with as much simplicity as possible, so as to dispense with the services of an engineer. A combination or compromise of these three desirable features is being sought for. Generally speaking, power for lighting and other purposes must be developed at the place where it is used, since it cannot be obtained from cities and villages in the district. None of the municipal lighting plants offer current for sale, even within their own districts.

Manufacturers of electrical supplies, for which the demand in Brazil is continually extending, will be interested to learn that considerable changes in the import duties have been decreed for such goods, the change in certain cases including the conversion from the former *ad valorem* basis to specific duties graduated by weight. The new rulings apply, *inter alia*, to dynamo-electric machinery and windmills, machine tools and pneumatic tools driven by electricity or compressed air, electric lamps, transformers, carbons, battery vessels, insulators and other electrical accessories.

Railway Matters.

THE accident of February 6th in Summit Tunnel, mentioned last week in our Notes for April, was the first since January, 1913, in which an accident report mentioned a signal having been frozen in the "off" position.

WE regret to hear of the death on the 4th instant at the age of seventy-five years of Mr. John Swinburn, who all his life was connected with the engineers' department of the Lancashire and Yorkshire Railway, latterly as principal assistant to the assistant chief engineer.

THE Queensland Government has decided to push on with the construction of a railway line to serve the Mount Oxide area as soon as it receives information that sufficient money has been secured to take up debentures to the amount approximating the cost of construction.

ELECTRIC lighting in the carriages of trains on the Victorian railways, which hitherto has been confined to the electrified portions of the suburban system, is being extended to the country trains. Gradually all the carriages on the rural systems in Australia will be fitted with accumulators.

THE South African Railway Administration now makes its own positive plates for train lighting at about half the cost of imported plates. Heavy losses from the theft of electric lamps from carriages, particularly on the Capetown and Johannesburg suburban services, have led to the lamps being enclosed.

THE testing locomotive at Purdue University, supplied in 1897 primarily as a result of the efforts of Dr. W. F. M. Goss, is to undergo a general overhaul and receive the application of several new parts and economy devices. The new work includes new cylinders and outside valve gears. In 1910 a Schmidt superheater was added.

AS a sequel to the incorporation of the independent railways in South Wales in the Great Western system, a new division has been created in the latter. It is to be known as the Cardiff Valleys Division. Mr. J. Cunningham, the Great Western Neath divisional engineer, is, as from July 1st, to be the engineer of the new division, and Mr. R. Carpmael, the Shrewsbury divisional engineer, succeeds Mr. Cunningham at Neath.

THE construction of a railway which will unite Bogota, in Colombia, with the navigable part of the Magdalena River and connect the capitals of the departments of Cundinamarca, Boyaca and Santander is expected to begin within the next three months. The concessionaires are to be financed with a loan of 15,000,000 dols., which has been arranged with a Franco-Belgian syndicate. The new railway will be known as the Ferrocarril Nordeste.

THE Railway Amalgamation Tribunal approved on Monday last the scheme for the amalgamation of the Barry Railway with the Great Western. This completes the amalgamation in the Great Western group. The Tribunal approved also of the absorption of some of the subsidiary companies that are to go into that group, but the whole scheme cannot be completed until all the subsidiary companies named in the schedule to the Railways Act have agreed.

THE Great Western Company obtained powers in 1911 and 1912 to build the Clydach, Pontardawe and Cwmgorse Railways. The main section is from Gwaun-cae-Gurwen, almost due south, to Felin Frau, and construction was begun in 1913, but stopped, by order of the Ministry of Munitions, in 1917. It is now proposed to complete the line as far southwards as Duke Colliery, and northwards to Craig Colliery. The intervening portion would necessitate the construction of a tunnel, and so it is postponed.

AT a meeting in London on Tuesday last of the general managers of the railway companies, it was agreed to introduce tourist tickets from June 1st next. Tickets will be issued at single fare and two-thirds for the double journey, for both first and third class. Attractive programmes of tours are being prepared, and will shortly be available at the railway stations. It is understood that the managers also had under consideration elaborate plans for summer excursion traffic—for long-period excursions and half-day excursions.

TWO standard gauge and three narrow-gauge Garratt locomotives have been placed in service on the South African railways. In certain tests made with a main line Garratt, it not only took a much greater load than the heavy main line engines, including a Mallet, against which it was tested, but its running times were better and its water and coal consumption less. The performances of all these Garratt engines, says the annual report of the Administration, have exceeded anticipations, but it would be unwise to regard their success as conclusive until they have had a more extended trial.

IMPORTANT suggestions were contained in a report recently presented to the New Zealand Minister for Public Works by a conference of public works engineers. One of the matters discussed was the substitution of roads for branch railway lines. The conference thought that when main lines of railway were being laid out, attention should be given to the provision of roads that would serve to feed the railway and give adequate means of communication to the settlers back from the line. The feeling of the engineers was against the multiplication of branch railways in view of the development of motor transport.

UNDER the caption "American Aid for Foreign Railways," the *Railway Age* (New York) said recently: "Why is it, then, that in most of the countries we have named—India, South America, Australia, China, Africa—we find the railways built and equipped upon lines suggested by the practice of Western Europe, where intense traffic is the rule? The answer is that capital from Western Europe built these railways and, naturally, patterned them after their own carriers (railways). Until recent years this country was in no position to build foreign railways, but lately we have advanced millions of dollars for railway development abroad, and the field for profitable investment in this direction is practically unlimited. The mere sending of dollars, however, is not enough. With money for development should go American equipment and American railwaymen."

Notes and Memoranda.

THE issue of the *S.A. Mining and Engineering Journal* for April 15th, which has just arrived in this country, contains some special articles on the mineral possibilities of the central part of the African continent, which suggest the likelihood of a vast extension of mining activity in the near future. There are also some interesting contributions on the explosives manufacturing industry of South Africa.

IN the "Transactions" of the South African Institute of Electrical Engineers, Mr. W. M. Mordey describes a scheme for separating iron ores which makes use of hysteretic repulsion. He has found that ferriferous particles are repelled by a magnet energised by polyphase current, and takes advantage of the phenomenon to separate into two streams a continuous flow of ore. Magnetite and hematite are deflected to one side, while the gangue goes straight on.

IN the course of a lecture to the Association of Drop Forgers and Stampers in Birmingham, Mr. Harry Brearley asked "Have you ever considered why we use so much 3½ per cent. nickel steel? Why the odd ½ per cent.? Why not 2 or 3 or 4 per cent.? and why does the mention of 3½ per cent. nickel steel always suggest a material containing 0.30/0.35 per cent. carbon? A reliable answer to these questions would be interesting. So far as my knowledge goes, nickel steel was first used on a large scale for the manufacture of guns, the amount of nickel specified being between 3 and 4 per cent. Such wide limits were necessary because at the time—about 1890—there were no means such as are now available of making rapid and accurate determinations of the amount of nickel in the bath of molten steel due to scrap. Three and a-half per cent. nickel was therefore a mean figure which allowed the greatest variation on either side. The carbon was 0.30/0.35 per cent. because the early carbon steel gun tubes had contained about that amount of carbon."

A SCHEME which should involve some unusual engineering features, which has been proposed by Professor Todd and Mr. McAfee, is described as follows in *Nature*. It involves "the construction of a 50ft. reflector of 1200ft. focus, by utilising a mine shaft of this depth at Chauaral, Chile, in the Andes, in the locality where Mars will pass exactly overhead at the opposition of 1924. The reflector will consist of rotating mercury, and there must be considerable incredulity about the possibility of keeping this sufficiently free from tremors and eddies to give tolerable definition. The plan ascribed to Professor Todd is to use a flat, which throws the image into a cave at the side of the shaft, where the camera would be put. But clearly, with such high magnification, the shortest practicable exposure would give a blurred image on a stationary plate. A much better plan would seem to be to put a girder across the mouth of the shaft, carrying a plate holder or eyepiece which could be moved by clockwork at the appropriate speed (about 1in. per second). This is known as the Schaeberle method in eclipse photography, and has given satisfactory results. Professor Todd is well known for bold and striking experiments, and all will wish him well, though without much expectation of success."

A NOVEL method of softening water is described as follows in the *Chemical Trade Journal*:—The treatment consists in merely pouring the hard water through a bed of raw peat, when the water will be found to have almost entirely lost its hardness. When the softening power of the peat has become exhausted, it is revivified by treatment with a hot dilute solution of common salt, sodium carbonate or caustic soda. The cause of this remarkable reaction is said to be the formation of insoluble or difficultly-soluble calcium and magnesium salts of the complex organic acids—humic or ulmic acids—that are a normal constituent of the peat substance, so that all the hardness is taken out of the water in passing through. A laboratory test is described in which 1000 grammes of dried peat were placed in a filter and hard water passed through until the peat was exhausted. There was then added 2000 c.c. of 25 per cent. salt solution at 150 deg. Fah., which was left in contact for two hours. The peat, after draining, will reduce hard water of 23.8 deg. of hardness to practically pure water of 1.75 deg. at the rate of 70 c.c. an hour. The filtered water is strongly alkaline, equivalent to 11 grains per gallon of sodium carbonate. It is difficult at the moment to see how this property can be utilised on a large scale, because of the necessity of reviving the peat with a hot solution of salt or other sodium compounds, and also the slow rate of filtration. It will be a fine achievement if the process could be adopted and provide an economical outlet for peat. The great similarity of this process to the permutit method will be apparent.

ACCORDING to an account in the *Colliery Guardian*, the wood preservative Ac-zol retains all the important properties of the older preservatives and eliminates their objectionable features. This preservative, as the name implies, is made up of ammonia, copper, zinc and phenol. The wood absorbs the solutions readily, and after the ammonia is evaporated, the salts of zinc and copper with carbolic acid, being neither corrosive nor conductors of electricity, are firmly and permanently embedded in the wood. The antiseptic qualities of these salts are well known. None of the vegetable parasites, worms or wood borers can live in their presence. At the Malines State experimental station in Belgium five sets of tests were made for the resistance to compression. The average results were for creosoted wood, 4125 lb.; wood treated with sulphate of copper, 7538 lb.; and Ac-zolated wood, 8164 lb. per square inch. Under tension the results were:—Creosoted wood, 5021 lb.; wood impregnated with copper sulphate, 5547 lb.; Ac-zolated wood, 8150 lb. per square inch. Four compression tests were made on behalf of the management of the Elizabeth colliery by the same authorities on treated and untreated timber. Natural wood showed a strength of 6614 lb. and Ac-zolated wood 12,829 lb. per square inch. The salts of the heavy metals contained in Ac-zol render the wood fire resistant, and so long as these salts have not been volatilised by high temperatures, their presence diminishes the fire danger. Six or eight parts of this solution with 94 or 92 parts of water is the proper concentration for treatment, which can be made either by immersion, a vacuum pressure treatment, or by application with a brush.

Miscellanea.

IT is expected that the new oil fuel berths on the Tyne at Jarrow will be ready for use by the end of June.

IT is reported that the Ceylon Government proposes to carry out the suggested hydro-electric scheme alone, but that a special staff of engineers will be engaged in England.

DURING January exports from the United States to China had a value of 7,600,000 gold dollars, an increase of 300,000 gold dollars over the previous month. Imports from China to the United States or January had a value of 10,600,000 gold dollars, an increase of4 5.9 per cent. over December.

IT is reported from Shanghai that a new ore concentration plant is to be constructed at Anshan, the site of the Anshan Iron and Steel Works, work thereon being commenced some time this year. The plan of construction, together with stat of the equipment of the plant, is said to have already been drawn up.

ACCORDING to a report from Petrograd, a preliminary agreement has been signed with a big German company for the reconstruction of the city. Under the agreement, it is stated, the German firm is to restore buildings, railways, water, sewage and other services, and in exchange will be permitted to carry on an earthenware and brick industry and to import wood products.

THE construction of a transhipment port at Verdun, connecting the Canal de l'Est with the system of the Compagnie de l'Est, is approaching realisation. The port, which will be built in the south part of Verdun, will contain a basin capable of receiving at least thirteen vessels of the ordinary type, and will be fitted with modern equipment. The port will be served by several railway lines, and the exploitation will be in the hands of the Bar-le-Duc Chamber of Commerce.

THE decree permitting the free importation into Russia of motor cars for State and private use has, it is reported, brought many offers from foreign firms. The Foreign Trade Commissariat is negotiating with foreign motor car manufacturers to establish branches in Russia on a mixed corporation basis. German, American and Italian companies, according to the Russian Trade Delegation, propose to institute omnibus and motor truck services to link up with railway stations, and also to construct an inter-urban railway from Moscow.

THE ancient gold mines of Troy are again receiving attention from a British company, which has received a two years' option on the concession. The discovery of a new lignite mine is announced in the Caza of Soma. It is reported that the Angora Government has been turning its attention to the exploitation of certain mines which previously had been little developed, especially in regard to the Bulgar-Maaden silver mine, for the working of which a scheme has been drawn up by which miners are to sell their production to the Government.

THE Swiss Federal Council, at a meeting on the 5th inst., considered the question of the navigation of the Rhine. The scheme for a canal connecting the Rhine with the Rhone through the Lakes of Geneva, Neuchâtel and Bienne has met with certain objections in Switzerland, the chief being that in the event of the water rising, some parts of the town of Basle would be in danger. The newspapers comment on a rumour according to which the British representative on the International Rhine Commission is said to have declared himself against the Swiss point of view.

ACCORDING to the Chinese Government Bureau of Economic Information, Dr. J. A. L. Waddell, the American engineer, at the request of the Chinese Government, has submitted plans for the construction of a bridge between Nanking and Pukow, and for a trolley system connecting Wuchang, Hankow and Hanyang. Both these schemes would necessitate crossing the Yangtse River, which, at Hankow, has a rise and fall of over 40ft. and a width of nearly a mile. At Nanking the conditions are not quite so difficult, but in each case headroom would be needed for the passage of ocean-going ships.

FOR nearly a year the Royal National Lifeboat Institution has been engaged in building the first of a new type of engine for its motor lifeboats. It is a more powerful engine than any hitherto used in a lifeboat, developing as it does 90 horse-power, and it was designed by the Institution's own experts, to meet the special and stringent requirements of the lifeboat service. The engine was practically complete, and would have been sent, within a week, to Cowes to be installed in the new motor lifeboat for Penlee, in Cornwall. Unfortunately, it has been very badly damaged by a fire at the Weyburn works, near Godalming, where it had been assembled. The accident means a delay of some months.

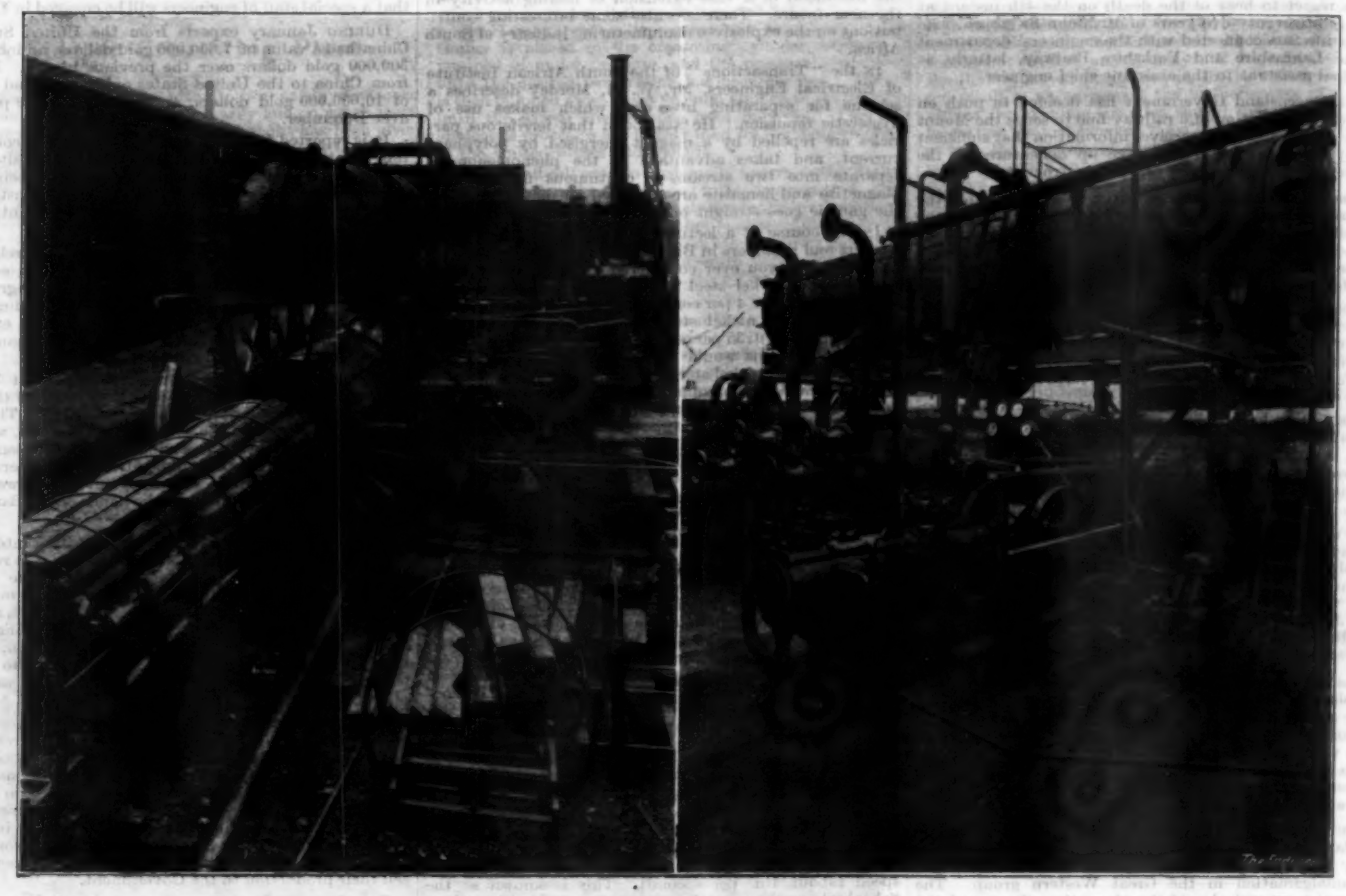
A CABLE message from Capetown says that preliminary preparations are being made for running experimental air mail services between Pretoria and Capetown by the South African Air Force for the purpose of testing the possibility of establishing regular commercial air services by private enterprise. All the facts ascertained during the experiments will be placed at the disposal of any company which is prepared to embark upon the development of air transport in the Union. Moreover, it is understood that the Defence Department will be willing to make the engineering facilities at its aviation workshops at Pretoria available to any commercial air transport firm with the undertaking that repairs will be carried out at cost price.

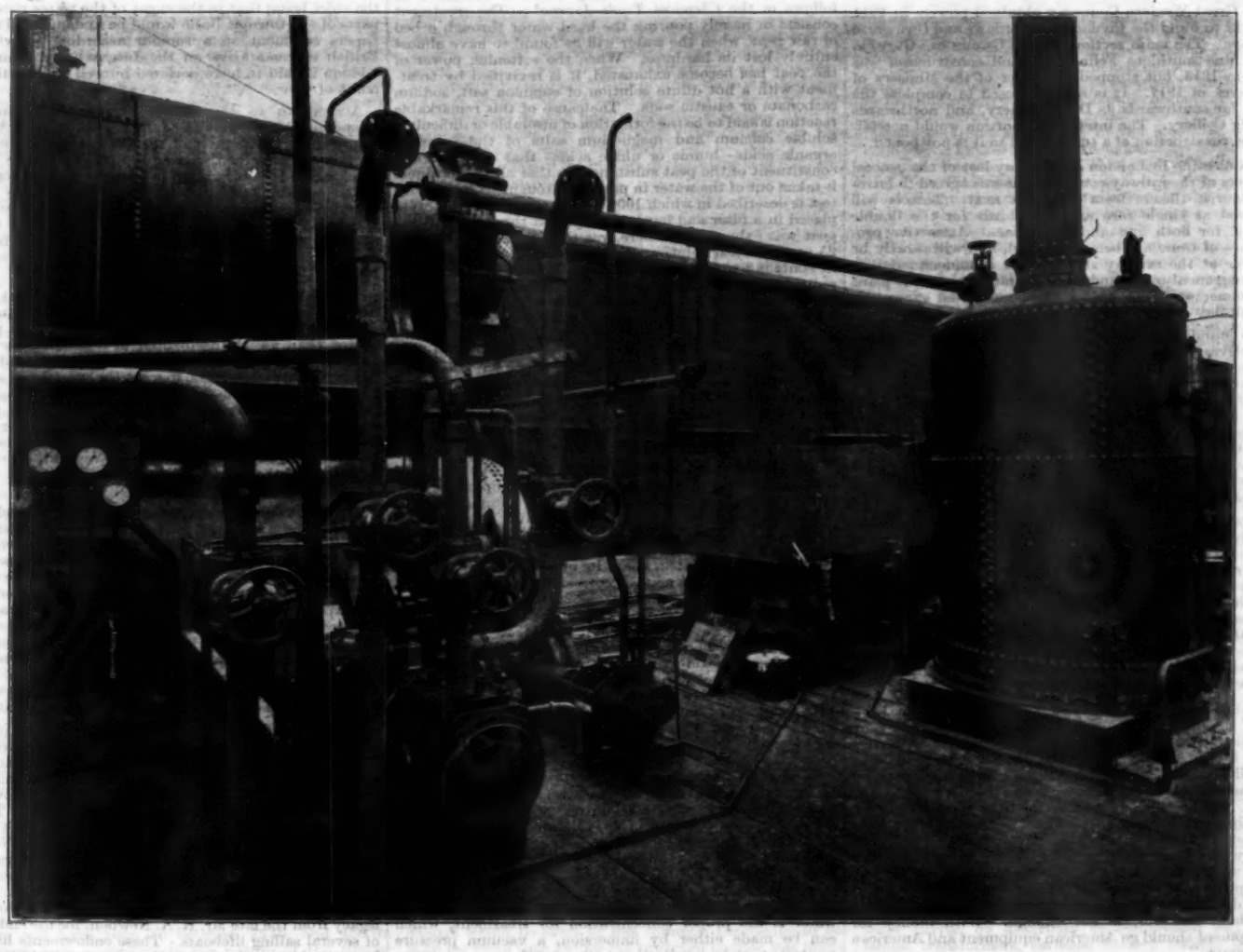
THE Royal National Lifeboat Institution has just completed two new motor lifeboats, one for Appledore, in Devon, and the other for Sennen Cove, Land's End. They are both self-righting lifeboats, 40ft. by 10ft. 6in., each is fitted with a Tylor engine developing 45 horse-power, and on their trials they showed a speed of 7½ knots. They are sister vessels to the new Brixham lifeboat, which went to her station a few weeks ago, and boats of the same type are being built for Selsey, in Sussex, and Bembridge, in the Isle of Wight. The Appledore boat has not yet been given a name, but the Sennen Cove boat is the Ann, Betsey, Lucy and Nancy Newbon, having been built out of a legacy from the late Mr. R. A. Newbon, for the endowment of several sailing lifeboats. These endowments have now been amalgamated to provide one motor lifeboat.

SLEEPER CREOSOTING PLANT FOR EAST AFRICA

BURT, BOULTON AND HAYWOOD, LIMITED, LONDON, ENGINEERS

(For description see page 524)





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THE ENGINEER.

MAY 12, 1922.

Imperial Wireless Communication.

THE paper on "Imperial Wireless Communication," which was read by Dr. Eccles, Vice-Chairman of the Wireless Telegraphy Commission, before the Royal Society of Arts, on Thursday of last week, has served to increase still further the general interest that is being taken in wireless affairs. From the abstract of the paper, which we publish on another page, it will be perceived that the author confines himself to a statement of facts which he considers ought to be in the possession of those who wish to form their own opinion upon the proposal to erect an Imperial chain of stations. For the most part these facts are historical, scientific and technical, but some of them have legal and economic bearings. Wireless telegraphy has already been involved in a great deal of litigation, and if the discussion on Dr. Eccles' paper gave a true indication, there is further trouble ahead. Although the Society of Arts is not exactly the quarter in which arguments on patent rights and State *versus* private enterprise might be expected to arise, these matters occupied much of the time of the meeting.

Very severe criticism concerning Dr. Eccles' remarks on the right of the Crown to use certain patents came from Mr. Godfrey Isaacs, who, after a spirited speech on the general legal aspect of the matter, summed up by saying that the Meissner patent referred to in the paper and all other German, French, American, and Marconi patents were the property of the Marconi Company, and whenever those patents were used, whether at Leafield or across the oceans, fair and proper remuneration must be paid. Dr. Eccles and others associated with the Commission appear, on the other hand, to be of opinion that because the Marconi Company was awarded £590,000 damages against the Crown for breach of contract, the Crown has the right to use the company's patents. This is a matter which is likely to lead to interesting developments in the future, but it is of greater interest to lawyers than to engineers. A point more closely allied to the technical side of the subject is the extent to which the various countries are falling into line with the Commission's recommendations. With this point Mr. Godfrey Isaacs also dealt. Canada, he said, abstained at least for the present, whilst Australia, India, and South Africa had all condemned the Committee's recommendations and had resolved upon direct communication. Australia had already joined with private enterprise and had entered into an agreement for the provision and working of stations. The French Government had decided that commercial wireless telegraphy could not be efficiently conducted by the Department of Posts and Telegraphs, and it had therefore entered into an agreement with the Compagnie Générale de Telegraphie sans Fil, under which that company is to erect stations and to conduct all the commercial services of France, not only with foreign countries, but also with the French Colonies. All this is very interesting, but it does not reveal where the differences in technical opinions lie. For light on that matter the Commission's recommendations pertaining to the range of stations must be compared with the remarks of Senator Marconi. Dr. Eccles and his colleagues have fixed the range at about 2000 miles, whilst Senator Marconi and other officials of his and other companies seem to consider that much greater ranges can be adopted. The Commission, it would appear, stands practically alone in the world in upholding the 2000-mile range. The paper under consideration shows that the policy of erecting stations spaced this distance apart is based upon the fact that the transmission of wireless signals is liable to be impaired by X's, strays, or atmospherics, and it is considered to be of little use to employ powerful magnifiers to increase the intensity of the enfeebled signals, for true and false signals would be magnified alike. But Senator Marconi did not agree with that view. There was no range, he said, that could not be covered satisfactorily if powerful stations equipped with suitable apparatus were used.

One thing the discussion did, if it accomplished nothing else, was to show that the opinions of those associated with the Marconi Company differ widely from those of the Wireless Telegraphy Commission. It is difficult to believe that Senator Marconi is unfamiliar with the true limitations which are imposed by atmospherics, and it is equally difficult to conceive that Dr. Eccles is unacquainted with the latest technical developments. What the Wireless Telegraphy Commission is obviously aiming at is to secure reliable and uninterrupted communication under all conditions, so as to ensure that the stations may be really useful and remunerative. Dr. Eccles himself shows that the American Government stations between Honolulu and Guam are separated by a distance of 4600 miles, but whether he considers the working satisfactory or not we do not know. Imperial wireless communication must, if it is going to be of real value to all, provide a good and uninterrupted service, and if there is any doubt as to the possibility of operating really long-distance stations satisfactorily, the Commission's recommendations ought to be accepted. The discussion left the whole matter in a very unsatisfactory condition. To find two eminent authorities such as Senator Marconi and Dr. Eccles in direct opposition on the question of the proper spacing of the stations for the Imperial wireless chain was probably a surprise to many who attended the meeting. Conflicting interests are, however, unfortunately very liable to lead to disagreements which might not otherwise arise, but it is to be hoped that in connection with this important work of building large and powerful wireless stations some endeavour will be made in future to avoid party controversies, which are apt to retard rather than further progress.

The Philosophy of Cutting.

BEHIND the art of cutting metals there lies the whole philosophy of cutting. About it we know relatively little, and it is just because it affords us some faint glimmerings of that philosophy that Professor Coker's paper, presented to the Institution of Mechanical Engineers, is interesting and valuable. As regards the art of cutting metals, that paper affords us little help, and unless Professor Coker's method can be taken much further than seems probable it not at all likely that it will ever give results comparable in workshop value with those obtained by the use of dynamometers and pressure indicators. It may, indeed, be said that in no case can it provide information of any practical value, since we have learnt by careful observation and experiment the best cutting angles and speeds for different metals, and that why those angles and speeds happen to be the best is not a matter about which the user need trouble his head. After all, the study of the cutting of metals is not taken up, like astronomy, for the expansion of man's intellect and the enlargement of his soul, but with the very humdrum utilitarian object of increasing output and reducing power so that bicycles and motor cars may be cheaper and that we may beat our competitors in foreign markets. Only in degree does it differ from the art of cutting bread and butter, and no one yet—perhaps wrongly—has thought of elevating that useful industry to the position of a science.

Fortunately there is in man an inquiring and

inquisitive nature. He likes to know why, and the philosophy of cutting, which may contain for all we know the germ of extraordinary developments, may thereby be saved from oblivion. We hope so. We hope that the science of it which Professor Coker is trying to pry into may be pursued, for there are many interesting problems behind the veil. To begin with, no one seems quite certain what cutting it. Is it shearing? Is it a delicate splitting of crystals or fibres? Is it a dissolution of molecular attraction by heat? Is it a complete breakdown of particles by concentrated pressure? Is it—as Mr. Brackenbury seemed to suggest in his remarks—a tearing rather than a cutting? Let anyone try to visualise the action of a metal turning tool and then make a concept of what is occurring during the process. Again, what is a sharp tool? An angle of 90 deg. is sharp if there is no rounding at the corner; but no one would think of attempting to shave with a 90 deg. razor or to cut wood with it. Why is 90 deg. sharp for cutting chilled rolls and 100 deg. blunt, and why are the particular angles that have been settled upon by experience for different metals better than other angles? Or, to push the matter further, what do lubricants do beyond the reduction of temperature? Why do we get a finer surface if we use soapsuds on steel instead of working dry? Thus could we go on multiplying questions and certainly receiving varying replies. Let us take at least one more problem. A slicing cut is both easier to make and smoother in result than a straight pressure. Why should it be? Why should the Japanese who walks up a ladder of sharp swords draw no blood so long as his foot does not slip sideways? Why in the carving of meat or cutting of bread must we move the blade to and fro? Is it because the sharpest of edges is saw-like in some measure, or because there is really some difference between shearing and cutting? Take a length of fine pine wood and square off the end with a paring chisel. Set the chisel for a cut one sixty-fourth of an inch or so from the end and it is easily pressed through. Move it back to a sixteenth and great pressure will not make it cut. Why? The bending of the chip resists the action, but the transverse strength of a chip on the end grain of pine wood is extremely small—too little, one would think, to make any appreciable difference by the quadrupling of its thickness. Mr. Brackenbury holds that the edge of a turning tool taking a heavy cut does not touch the work once it has entered. After that the cut precedes the point. The metal, so to speak, is split off; there is always a visible gap between the cutting edge of the tool and the steel it is turning. Furthermore, as Colonel Crompton showed by a series of photographs, and as everyone who has watched heavy cutting knows by experience, a crater is formed some distance behind the edge and changes the shape of the tool. If both these observations are correct—and we do not doubt them for an instant—why is efficiency affected by the particular angle of the tool? These phenomena are observed with heavy cuts. What happens with light cuts? Is there only a change of degree or is there also a change of method? The late F. W. Taylor, in his celebrated paper on "The Art of Cutting Metals," gave as good a description of the action of cutting steel as anyone has ever given. He noted particularly that the real cutting tool acts in a wedge-like manner, both faces pressing on the material to be severed; whereas in metal cutting only one face, the "lip surface," ever presses against the metal. "Thus," he says, "'cutting' with a metal cutting tool consists in pressing, tearing, or shearing the metal away with the lip surface of the 'wedge' only under pressure, while in the case of the axe and other kinds of cutting both wedge surfaces are constantly under pressure." From that basis Taylor described with much care how the chip was formed; but after all he does not take us much further than we were.

We are sure that every one of these questions, and many another, has at some time presented itself to our readers. We know that answers have been given to some of them. We are not certain that the answers are wholly satisfying. The admirable descriptions that have from time to time been given of the production of a turning are rather the records of observations than the explanation of them. They are the groundwork for the philosophy of cutting, not the philosophy itself. That philosophy may be about as valuable in the workshop or the market-place as the Einstein theory; but still we should like to have it, and we trust Professor Coker will pursue his optical method further. It may do no more, in the first place, than show us what happens when we cut slabs of nitro-cellulose; but unless there are different phenomena for different materials, it ought to throw some light on the cutting of metals. It is not very likely that we shall be any nearer increasing the efficiency of cutting by knowing all about it. The empirical method has probably given us just the information that is useful to us, but it would be satisfying to know more, and it is just possible that it might be of service to us. One never knows whither science leads.

Obituary.

NORMAN J. LOCKYER.

THE death is announced of Mr. Norman J. Lockyer, who, at the time of his death, was manager of the North-Eastern Railway Company's Darlington works.

Mr. Lockyer, who was in his sixty-third year, was the eldest son of the late Sir Norman Lockyer. He was educated at University College, London, and commenced his engineering career at the works of Sir Joseph Whitworth and Co. Subsequently, he joined the staff of the Manchester, Sheffield and Lincoln Railway, afterwards the Great Central line. Later he spent a period with the London, Brighton and South Coast Railway Company, and also was engaged by the firm of Sir Alexander M. Rendell. In 1897 Mr. Lockyer was appointed works manager of Sharp, Stewart and Co., Limited, Glasgow, which is now part of the North British Locomotive Company, Limited.

In 1899 Mr. Lockyer entered the service of the North-Eastern Railway Company as works manager of its shops at Gateshead, at which place the company's headquarters then were, and where all the building of locomotives was undertaken. In 1910, when headquarters were transferred to Darlington, Mr. Lockyer went there as works manager. Large numbers of the Gateshead foremen and men were transferred at the same time, and Mr. Lockyer had the responsibility of amalgamating the working staffs.

As an engineer, Mr. Lockyer showed exceptional ability, and during the time he was at Darlington works he was responsible for the construction of engines of large and varied designs, including the electric locomotives for the Shildon and Newport area, together with all the various work connected with a big locomotive shop. During the war he also had charge of the company's shell shop, which was laid down to assist in the production of munitions, and during that time over 1,000,000 18-pounder shells were manufactured, and other Government work carried out under his supervision.

Mr. Lockyer was highly esteemed by the officials and staff, and his comparatively early demise is deeply regretted.

The Development of Diesel Engines for Naval Purposes.

IN an informative and historically interesting paper read before the Institution of Engineers and Shipbuilders in Scotland last month, Vice-Admiral Sir George Goodwin, Engineer-in-Chief of the Navy, gave an account of the development which has taken place in connection with Diesel machinery for naval purposes, and outlined the position which has now been reached. Brief reference was made to the early experiments with Hornsby-Ackroyd engines in three battleships, which, while not entirely successful owing to difficulties experienced when working with heavy fuel oils, undoubtedly established the great advantages of oil engines for emergency and stand-by purposes, and caused them to be further considered for electric generating purposes. The Dreadnought was provided with two Diesel-driven dynamos, each of 100 kilowatts capacity, the engines being of the high-speed type running at 400 revolutions per minute. Initial difficulties, due to want of stiffness in the foundations upon which the engines were placed, were experienced, and some modification in the design of the air compressor was necessary, but when these alterations had been made more satisfactory running was obtained, and engines of smaller design, but with the air compressor driven from the end of the crank shaft, were installed in the battle-cruisers of the "Indomitable" class and the battleships of the "Bellerophon" class. Difficulties were still met with, owing largely to lack of experience and a *personnel* educated on steam plants, but the more serious troubles were gradually eliminated and fairly satisfactory results obtained.

It is of interest to note that as the *personnel* became better acquainted with Diesel engines the desire for them was in some cases so great that they were preferred to reciprocating steam engines. The economy was very marked, one ship using only 35 tons of oil for the Diesel engine as compared with 350 tons of coal for a reciprocating steam engine doing the same work.

Speaking of the position to-day, Sir George Goodwin said that although it could not be stated that oil engines were as reliable as steam turbine plants, the results on the whole were satisfactory, and that although the upkeep was greater, the gain in economy outweighed the other disadvantages. Reference was made to the higher standard of workmanship required for the manufacture of Diesel engines, and it was pointed out that in some details this high standard was not required. Probably if a mixed standard could be permitted with a very high accuracy for the vital parts and a lower standard for the less important parts, the first cost of the engine might be reduced without detracting from its efficiency, reliability, or durability.

Dealing with the use of Diesel engines for propulsive purposes, Sir George Goodwin recalled the first two engines supplied for the 50ft. Dreadnought pinnaces, which were of the non-reversing type, and difficulty was experienced with the clutch and reversing gear. There was also a lack of flexibility. Early in 1911 it was arranged to fit a combination of oil engines and turbines in a torpedo destroyer, but difficulties were experienced in manufacture, and the scheme was not carried through. When designing the Hood it was proposed to fit two sets of eight-cylinder engines, each of 4500 horse-power running at 185 revolutions per minute on the wing shafts with three sets of turbines on the centre shaft, but these proposals were subsequently abandoned. The successful operations of the oil engines on the monitor Marshal Soult and the oil tank vessel Trefoil were also mentioned.

About the end of 1913 the final trials of the 1000 brake horse-power two-stroke cycle built for the Admiralty by Messrs. Vickers took place, and satisfactory results were obtained. This engine had a cylinder diameter of 30in. with a piston stroke of 36in., and ran at a speed of 140 revolutions per minute. During a full-power trial of 103 hours a mean horse-power of 1044 was maintained, and the fuel consumption of the main cylinder alone during this period was 0.405 lb. per brake horse-power-hour. Some time before the war, Diesel machinery for three 10,000-ton tankers was ordered by the Admiralty from Messrs. Carels, Sulzer, and the M.A.N. Company, but owing to the war the Sulzer engines only were delivered, and opportunity to use them did not arise.

The circumstances leading to the adoption of the Vickers four-cycle solid injection type of engine for standard submarine practice were described, and reference made to the inauguration of the Admiralty Engineering Laboratory during the last year or so of the war. In the latter, it was explained, experiments had been carried out on the use of aluminium pistons, and experimental engines by Messrs. Vickers, Beardmore, and J. S. White had been tested. Some of the latter worked on the four-stroke cycle and some on the two-stroke cycle. A double-acting two-stroke cycle engine of large size had, said Sir George, been designed, and was in course of construction for the laboratory, and from it it was hoped that valuable data would be obtained.

In conclusion, Sir George expressed it as his opinion that at the present time not only could it be claimed that the Admiralty, with the valuable assistance of oil engine makers, had succeeded in removing to a very great extent the reproach that the British Navy was behind some continental navies with regard to oil engine development, but that it was in a fair way, in the course of the next few years, provided the experimental work could be continued, to take up a position in the front rank of such work.

UNITED STATES PATENT APPLICATIONS.

THERE has recently been published in the United States *Official Gazette* the Commissioner's *résumé* of the patent position for the year 1921. It provides a general guide to commercial matters in the United States and to a certain extent affords an interesting comparison with the patent position in this country. According to the report, the United States Patent Office finds increasing difficulties in keeping up to date in its patent work—a fact which is already known to many British inventors.

In July, 1919, 18,000 applications were in arrear; by December, 1920, the figure rose to 40,000, while at the end of last year it had become 61,000. In part, this delay was due to the fact that out of a staff of 437 trained technical examiners, 184 had resigned. It is difficult to replace these men because of their combined legal and scientific training. Furthermore, the patent applications increased 53 per cent. in 1921 compared with 1918, and design applications were raised by 150 per cent., the figure for trade marks being 137 per cent. The years 1919, 1920 and 1921 showed successive records in the number of applications filed.

The report gives several quotations from American papers to the effect that American business is considered to be essentially built up on patents, and that the result of having to wait from six to eight months for the examiner's decision on applications is sometimes disastrous. It appears that an application at the present time is not normally dealt with until ten months after filing, unless the case is what is termed "made special," in which instance a patent may be brought to the allowance stage within thirty days. This of itself tends to delay other cases.

On the business side, the Patent Office sells monthly 200,000 printed specifications at 10 cents, or just over fivepence per copy. The price in this country for British specifications is 1s.

The United States inventor is charged 20 dols. for printing his patent. The cost being about the same to print one hundred specifications as one, he practically pays for the hundred although he only receives one, the rest being sold or used for office purposes. As 40,000 patents are granted each year, the Patent Office thus has accumulated about 40,000,000 copies of specifications.

The total Patent Office receipts for 1921 were 2,775,982 dols. and the expenditure came to 2,612,429 dols. The applications for patents for inventions numbered 87,408, for designs 5596, and for trade mark registration 16,234. The applications allowed for patents numbered 48,536 and for designs 3337. The patent applications filed in Great Britain total about 30,000 per annum. It is interesting to note the number of patents granted in the year in the United States of America to residents of other countries. These figures include: Alsace-Lorraine 1, Argentine 36, Austria 23, Belgium 46, Canada 809, China 2, England 146 (or, taking into account Ireland, the Isle of Wight, Scotland and Wales, 262), France 426, Germany 352, India 16, Sweden 257, and Switzerland 161. It will thus be seen that this country does not by any means stand first in the list.

Developments in Power Station Design.

No. XXIX.*

Two surface condensers have recently been installed in the Bankside station of the City of London Electric Light Company, and each is designed to deal with 170,000 lb. of steam per hour from Oerlikon 10,000-kilowatt turbines. Both these plants, which are shown in Fig. 155, have been built and erected by the Mirrlees Watson Company, Limited, of Scotland-street, Glasgow, and will give a vacuum of 29in. when supplied with 14,400 gallons of circulating water per minute at a temperature of 55 deg. Fah. The cooling surface in each case is 15,000 square feet. The diameter of the shell is 8ft., whilst the length between the tube plates is 16ft. 2½in. Each casing, which is composed of cast iron, has water heads and covers with removable inspection doors. The tubes, which are ¾in. in external diameter, are composed of a mixture of 70 per cent. copper and 30 per cent. zinc. There are eight sections, which are permanently bolted together, and the circulating water passes through the condensers in two streams. The air is removed by steam ejector air pumps, as shown in the right-hand lower corner of Fig. 155. These ejectors are of different sizes, one set being used when the condenser is working at two-thirds of its load and the other at one-third load, whilst when the plant is operating at its full output all the ejectors are put into use.

Practically the whole of the heat in the operating steam is recovered, as the water used for condensing the steam from the first stage in the intermediate condenser is taken from a shunt on the main condensate pump discharge, and the condensed steam from this stage is intermingled with the water and returns to the suction side of the condensate pump, whilst the steam and air discharged from the second ejector are led to the feed-water heater, where the heat from the steam is recovered in the ordinary way. The ejectors are designed to operate at a steam pressure of 100 lb. per square inch, but they will also work at any higher pressure. The condensate pump, which is an electrically driven machine with a gun-metal impeller, is capable of delivering the condensate against a manometric head of 35ft.

The Delas air extractor, which has been introduced by La Société Condenseurs Delas, of Paris, and which is being made under licence in this country by Cole, Marchent and Morley, Limited, of Bradford, is claimed to eliminate the instability experienced when arrangements of this sort are used for very high vacuum with varying conditions of steam pressure and air extraction. Designers of air extractors, the makers explain, have previously resorted to the practice of introducing air at atmospheric pressure at certain points where the internal pressure is below that of the atmosphere; but this method of overcoming the difficulty is considered to be illogical. In the first place, it is contended, the remedy is incomplete, because, to steady the action of the ejector, the inflow of the air will be intermittent, and secondly, a certain amount of work has to be performed in re-compressing the stabilising air to the atmospheric pressure, and this work has to be done by the steam in the nozzles. This additional work reduces the efficiency of the apparatus and therefore necessitates an increase in the steam consumption. In the P V diagram shown in Fig. 156 the compression line C H D, which ought to be adiabatic, becomes under actual working conditions the line C H F G D and the area H F G D represents the additional work required from the working fluid. The principle of the Delas air extractor will be readily understood from the Drawing II. in Fig. 159.

It is known that the degree of vacuum depends on the distance indicated by the line D, *i.e.*, the distance between the throat of the diffuser A and the end of the steam nozzle B, and by increasing this distance the friction surface and the weight of the air withdrawn are increased, with the result that a higher vacuum is produced. If, however, the distance is made too great, a drop in vacuum is produced and, owing to a constantly increasing rise in the temperature of the convergent, the ejector ultimately fails. The designer of this new ejector, therefore, commenced his investigations on the assumption that failure is started by the increase in this temperature, and drew the natural conclusion that failure would be obviated if the convergent were kept cool. In order to prove that this was correct, an extractor A (see the Drawing IV.) was fitted with a water jacket B which encircled the convergent, and the apparatus was first of all started up without any water within the jacket.

The distance between the steam nozzle and throat of the diffuser was then gradually increased until the apparatus failed, when the vacuum gauge only registered 11in., but when the circulating water was introduced into the jacket the vacuum was increased to 28in. Normal working was then resumed, and by still further removing the nozzle a still greater weight of air was withdrawn and a better vacuum was therefore secured. By the simple expedient of using cold water in the manner described instead of introducing air at atmospheric pressure into the divergent, unstable working conditions were overcome and the extractors, which are now being made in accordance with this principle, are said to give a very high vacuum under all working conditions. It has been proved by careful experiments carried out with varying steam pressures and degrees of air extraction that the stability of these extractors is exceptionally good and that failure is practically impossible even with very low pressures at the nozzles and a large increase in the amount of air extracted.

It is well known that an air extractor is an apparatus in which the extracted air is compressed to atmospheric pressure in the diffuser. In a convergent-divergent diffuser of the ordinary type the compression is adiabatic and the temperature at the discharge outlet shows an appreciable amount of superheating, which results in some cases in a temperature as high as 518 deg. Fah. The Delas extractors, however, give a discharge temperature between 212 deg. and 215 deg. Fah., which practically corresponds to atmospheric pressure. In the first case the compression line is therefore adiabatic, as shown at C D in Fig. 157, and in the second case, with the cooled diffuser in use, it is isothermic, as shown by the line C E. The area C D E between these curves represents the work which the water circulation renders unnecessary, and the apparatus is therefore able to perform its duty with a reduced steam consumption. The diagram Fig. 158 is a combination of the diagrams Fig. 156 and Fig. 157, and the total gain is represented by the area C E D G F H C.

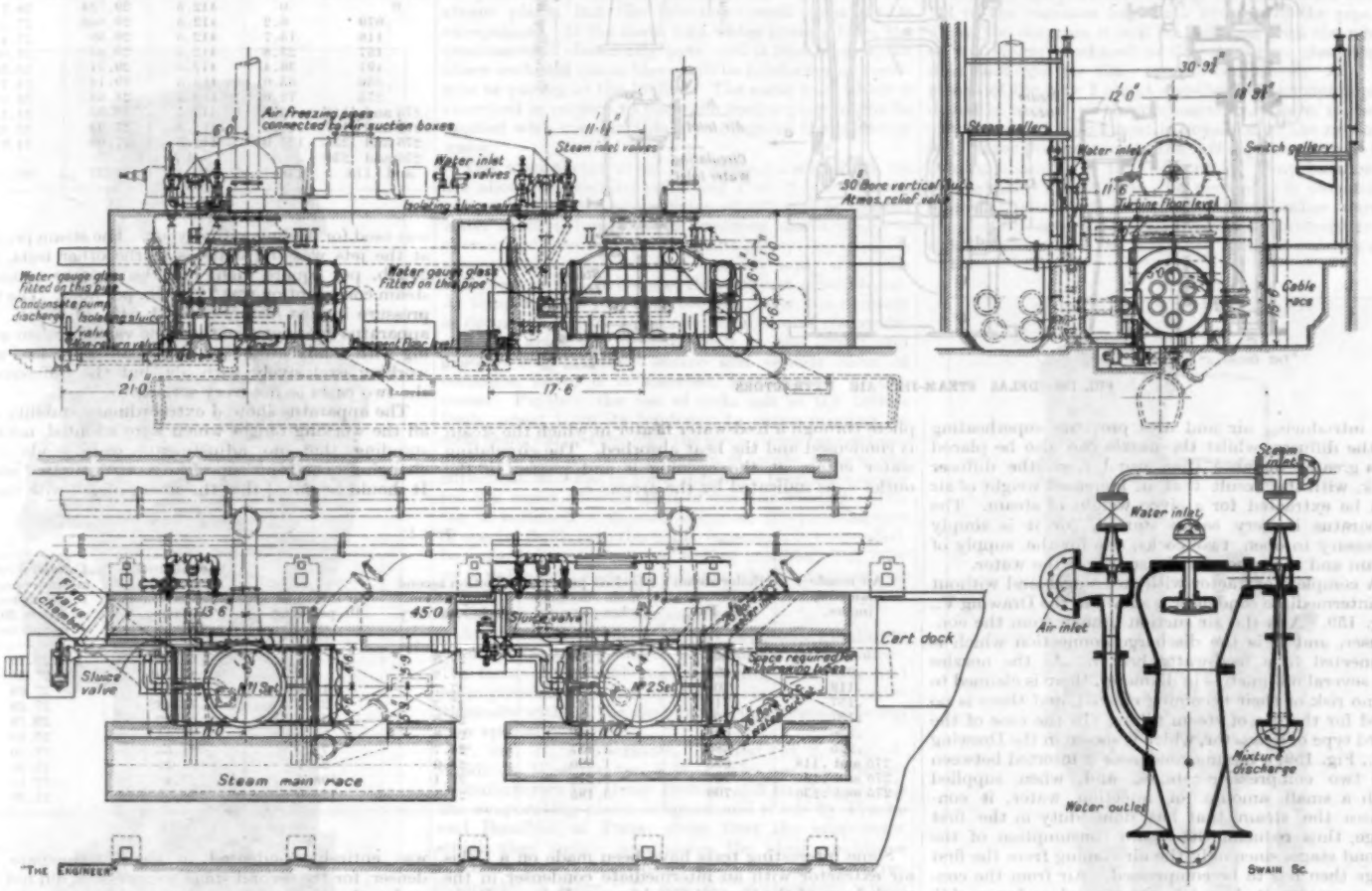


FIG. 155—GENERAL ARRANGEMENT OF MIRRLEES-WATSON CONDENSING PLANT, AND SECTION OF AIR EJECTOR

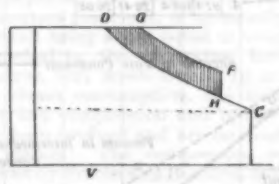


FIG. 156

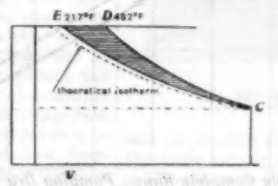


FIG. 157

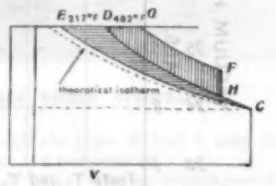


FIG. 158

Three types of these extractors are made: single stage, double stage, and a double-stage extractor with an intermediate condenser. In the first case the apparatus has a single nozzle and is arranged as shown in the upper part of the Drawing I. in Fig. 159. The working steam for the double-type extractor without an intermediate condenser enters through the opening A in the Drawing I., Fig. 159, and the air is extracted from the condenser through the passage B, whilst the mixture is discharged through the end C to the feed tank. The cooling water which is drawn from the condenser circulating water system enters at D and passes out of the apparatus at E, and, with the exception of the small amount of heat, carried away

* No. XXVIII. appeared April 28th.

by the circulating water, all the heat units in the working steam may be recovered in the feed water. The improved efficiency of the apparatus is due to the fact that the water cooling eliminates the necessity

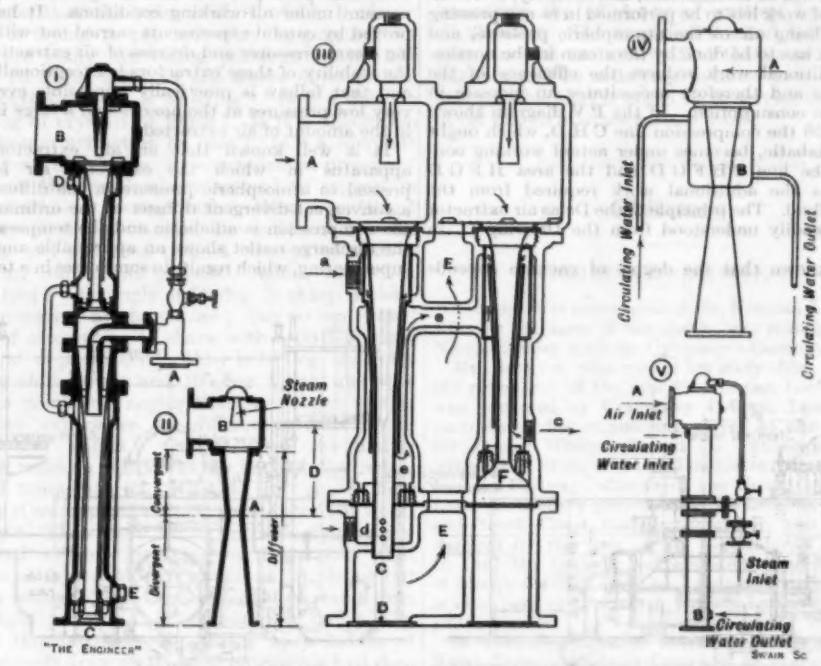


FIG. 159—DELAS STEAM-JET AIR EXTRACTORS

for introducing air and also prevents superheating in the diffuser, whilst the nozzle can also be placed at a greater distance than usual from the diffuser neck, with the result that an increased weight of air can be extracted for a given weight of steam. The apparatus is very easily started, for it is simply necessary to open two cocks, one for the supply of steam and the other for the supply of the water.

A complete extractor with two stages and without an intermediate condenser is shown in the Drawing V., Fig. 159. A is the air suction branch from the condenser, and B is the discharge connection which is connected to a feed-water heater. As the nozzles are several millimetres in diameter, there is claimed to be no risk of their becoming choked, and there is no need for the use of steam filters. In the case of the third type of extractor, which is shown in the Drawing III., Fig. 159, a mixing condenser is inserted between the two compression stages, and, when supplied with a small amount of injection water, it condenses the steam that has done duty in the first stage, thus reducing the steam consumption of the second stage, since only the air coming from the first stage then has to be compressed. Air from the condenser enters at A and is compressed as far as *d* C. A jet of injection water is then admitted through the holes *d* and condenses the steam in the first stage, the injection water and condensed steam flowing away through the outlet D and returning to the main condenser through a U tube. The incondensable gases which are now freed from steam are drawn along in the direction of the arrows E and are compressed a second time as far as F, when, together with the steam of the second stage, they are discharged to the atmosphere through a feed-water heater in which the steam is condensed and the heat absorbed. The circulating water enters at the opening *a* and passes to the outlet *c*, as indicated by the arrows *e*.

Some interesting tests have been made on a Delas air extractor with an intermediate condenser in the workshops of the Société Condenseurs Delas at Paris. The apparatus was tested at its full capacity and was used for pumping dry air when working alternately with superheated and saturated steam. Some supplementary tests were also made with a view to ascertaining comparative results when the extractor is dealing with air mixed with definite quantities of saturated steam, representing the vapour conditions which apply in practice. The results of some of the tests are shown in the following tables and in the curves given in Fig. 160.

In the case of the first test the extractor was working with superheated steam and was dealing with dry air. The back pressure of the exhaust was 3.28ft. of water, the steam pressure at the jets was 242 lb. per square inch, and the steam consumption was 600.5 lb. per hour. In test 5 saturated steam was used for dealing with dry air. The steam pressure at the jets was the same as in the other tests, viz., 242 lb. per square inch, but the average saturated steam consumption was 715.7 lb. per hour. The back pressure in this instance was 1.64ft. of water. The apparatus does not give the same vacuum when working with a mixture of air and steam as it does when working exclusively with air, but the difference in the two cases is not very serious.

The apparatus showed extraordinary stability over all the working ranges which were adopted, notwithstanding that no adjustments were made when changing over from superheated to saturated steam. It should be noted that the steam mixed with the air was entirely condensed in the intermediate condenser, for the second stage compression did not alter under the two conditions of working. In the subsidiary test indicated by T4 on the curve the

Test 5.

Air nozzle diameter, inches.	Air passed and dealt with by extractor, lb. per hr.	Average steam temperature at boiler of deg. Fah.	Vacuum with barometer 30in. of mercury.	Intermediate stage. Vacuum with barometer 30in. of mercury.
0	0	412.5	29.724	28.27
.079	6.2	412.5	29.666	27.68
.118	13.7	412.5	29.59	27.41
.157	23.8	412.5	29.45	27.02
.197	36.4	412.5	29.31	26.58
.236	53.0	412.5	29.14	24.19
.275	72.0	412.5	28.55	24.90
.275 and .118	85.7	412.5	28.35	24.15
.275 and .197	108.4	412.5	27.92	23.02
.275 and .236	125.0	412.5	27.60	21.92
.275 and .236 and .118	138.7	412.5	27.37	20.94

Test 1.

Air nozzle diameter, inches.	Boiler steam temperature, deg. Fah.	Absolute pressure main suction, inches mercury.	Suction second compression, inches mercury.	Air introduced, lb. per hour.	Vacuum inches mercury, barometer 30in. mercury.	Corrected intermediate pressure inches mercury, vacuum 30in. barometer.
0	665	.236	27.8	0	29.764	27.76
.079	695	.295	27.8	6.2	29.705	27.84
.118	707	.354	27.7	13.7	29.646	27.68
.157	717	.512	27.3	23.8	29.489	27.29
.197	709	.670	26.8	36.4	29.33	26.76
.236	690	1.062	25.8	53.0	28.94	25.80
.275	680	1.457	24.7	72.0	28.55	24.70
.275 and .118	695	1.690	23.9	85.7	28.31	23.95
.275 and .197	700	2.210	22.1	108.4	27.8	22.15
.275 and .236	700	3.185	21.2	125.0	26.82	21.20

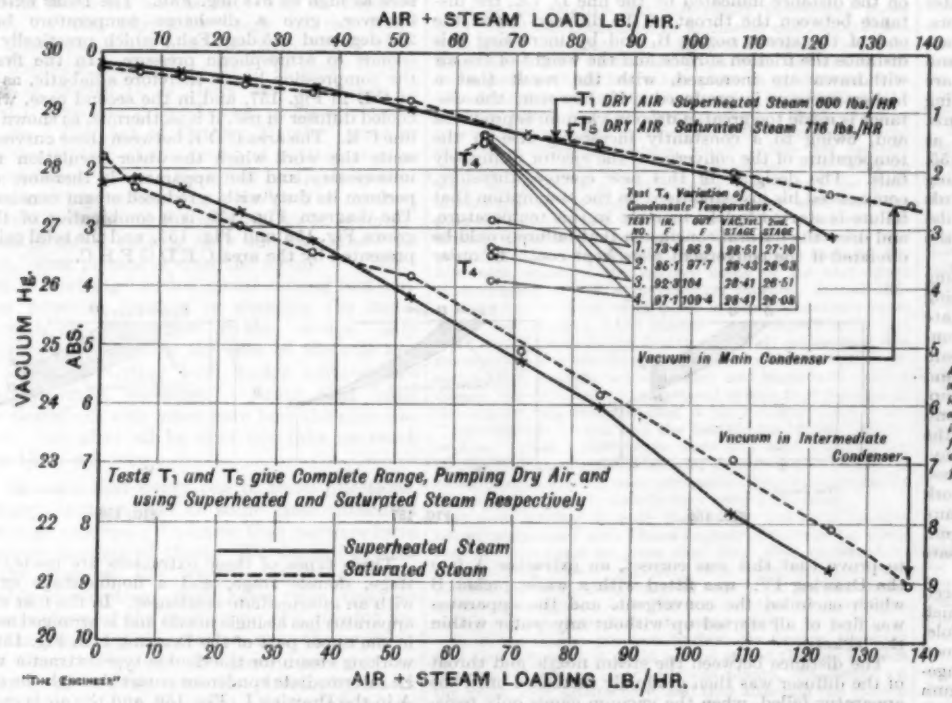

AIR + STEAM LOAD LB./HR.
VACUUM Hg. ABS.
T1 DRY AIR Superheated Steam 600 lbs./HR
T5 DRY AIR Saturated Steam 716 lbs./HR
T4
T4
Test T4 Variation of Condensate Temperature.
TEST NO. | IN. F | OUT F | VAC. 1st STAGE | 2nd. STAGE
1. 73·4 | 86·9 | 28·51 | 27·10
2. 86·1 | 97·7 | 28·43 | 26·63
3. 92·3 | 104 | 28·41 | 26·51
4. 97·1 | 109·4 | 28·41 | 26·03
Vacuum in Main Condenser
Vacuum in Intermediate Condenser
Tests T1 and T5 give Complete Range, Pumping Dry Air and using Superheated and Saturated Steam Respectively
Superheated Steam
Saturated Steam
AIR + STEAM LOADING LB./HR.
"THE ENGINEER"

FIG. 160—CURVES SHOWING RESULTS OF TESTS ON DELAS AIR EXTRACTORS

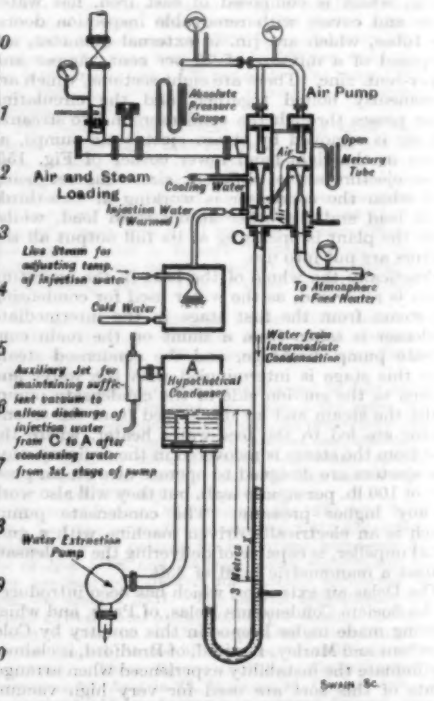

Absolute Pressure Gauge
Air Pump
Open Mercury Tube
Air and Steam Loading
Cooling Water
Injection Water (Warmed)
Live Steam for adjusting temp. of injection water
Cold Water
To Atmosphere or Feed Heater
Water from Intermediate Condensation
Auxiliary Jet for maintaining sufficient vacuum to allow discharge of injection water from C to A after condensing water from 1st. stage of pump
A Hypothetical Condenser
Water Extraction Pump
3 Metres
SWAIN Sc.

FIG. 161—EXPERIMENTAL APPARATUS

the experimental apparatus. The lower group of points marked T4 on the curve relate to the intermediate condenser and the upper points to the complete plant. The vacuum in the inter-condenser naturally followed the temperature of the injection water; but the ultimate result was that the one stage took up the work that the other stage was compelled to drop, thus showing that the apparatus is not particularly sensitive to condensate temperature and can therefore work at a high efficiency when connected to the actual condenser.

The experimental apparatus only admitted a limited range for the tests, but some other trials made on an extractor fitted to a 6000-kilowatt set in the Billancourt central station show that the apparatus gives excellent results under practical conditions. After the first stage had been in operation for eighteen minutes a vacuum of 25.3in. was produced, whilst, after bringing the second stage into operation, the vacuum increased to 29.5in. in three minutes. A

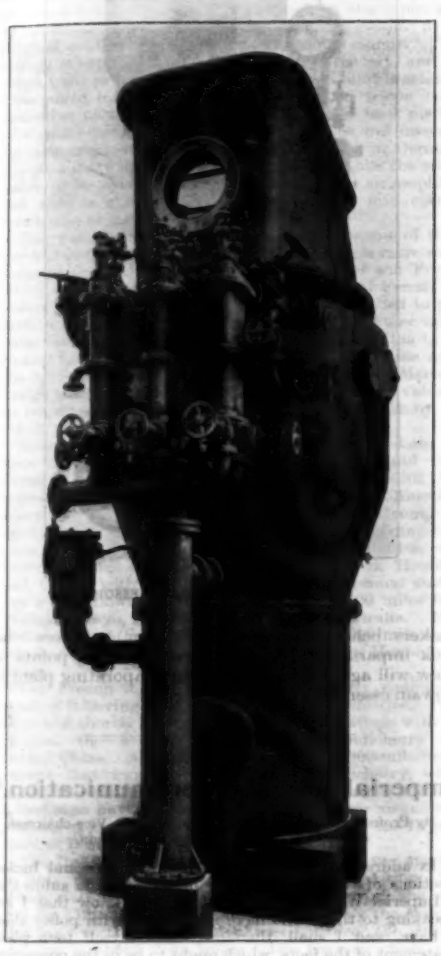


FIG. 162—JET CONDENSER WITH DELAS AIR EXTRACTORS

comparison of the steam consumption of a Delas extractor with those of other well-known types indicated that the former was by far the most efficient, and the actual saving in steam consumption with various degrees of vacuum is shown below:—

Vacuum. Inches.	Saving in steam consumption. Per cent.
28.25	24.9
28.5	19.0
28.75	22.4
29.0	20

A jet condenser equipped with three sets of Delas steam jet air extractors is shown in Fig. 162. This is one of a pair of jet condensing plants supplied to the British Thomson-Houston Company for use in conjunction with a mixed-pressure turbine at the Llanbradach Collieries. Each of these condensers is capable of dealing with 82,000 lb. of steam per hour whilst maintaining a vacuum of 27½in. with cooling water at a temperature of 75 deg. Fah., the air extractors being capable of extracting 170 lb. of air per hour. The injection water extraction pump is of the centrifugal type. It has a capacity of 295,000 gallons of water per hour, runs at a speed of 720 revolutions per minute, and requires 113 horse-power to drive it. The condenser itself is of the low-level nozzle type, in which the steam on entering passes a series of water jets at high velocity, and the mixture passes through a converging cone to the bottom of the condenser, from which it is withdrawn by the extraction pump. The air and vapour which rise to the outlet are extracted from the coolest part of the condenser. A vacuum breaking valve ensures safe working. The air is extracted by means of three Cole, Marchent and Morley Delas compound steam jet air extractors of the intermediate condenser type, and any combination of the jets can be used. The height of the plant measured to the top of the shell is 12ft. 6in., the height to turbine exhaust outlet 17ft. 6in., and the external diameter of the condenser shell 7ft.

Reference has already been made in this series of articles to the practice of evaporating the make-up feed water in power stations, but little has so far been said concerning the apparatus which is available for that purpose. Considerations relating to fuel consumption or the rapid progressive fall of thermal efficiency due to incrustation, with its attendant evils of frequent cleaning and renewal, have it is asserted had a good deal to do with the disinclination to employ evaporators in power stations in the past; but there seems to be little doubt that the practice of evaporating the make-up water is steadily gaining favour.

The amount of water which has to be added continuously to the feed system is estimated to vary from 3 to 12 per cent. according to the efficiency of the jointing material and packings associated with the steam plant, but the first-mentioned quantity is exceptional. If the main feed water coming from the condensers is chemically pure and is free from air or other occluded gases, there will be no danger of corrosion or pitting in the boilers. The same care which is exercised in respect to the main feed supply might be applied with considerable advantage to the make-up water.

The manufacturers of the evaporators which we are about to describe point out that it is erroneous to assume that the evaporation of softened or treated water at high temperature produces steam which is chemically pure. In all raw feed waters, they explain, magnesium compounds are present and, with the exception of the carbonate, they are not precipitated. At temperatures just over 100 deg. Cent. the chloride is decomposed into hydrochloric acid and magnesia, and the acids are present both in the liquid and gaseous state. Many severe and serious cases of corrosion have, it is asserted, been traced to this cause. Further, the use of soda ash in the boilers leads, apart from its tendency to cause priming, to soda being carried through the main steam connections and gives rise to the destruction of joints, reduces the superheat, and has in some instances been responsible for the rapid deterioration of turbine blading. The use of softened or treated water or the introduction of special fluids into the boiler cannot, it is contended, be regarded as a cure for scaling troubles, but only as a palliative, and any scheme which promises the entire elimination of these troubles can scarcely fail to interest power station engineers.

An ideal evaporator should combine maximum economy with continuous satisfactory performance. The formation of scale on the heating surfaces should be impossible and the apparatus should work automatically without the use of an air or extraction pump or a special condenser.

P. and B. Evaporators, Limited, of 2, Central-buildings, Westminster, S.W. 1, who are the licensed manufacturers for Great Britain and its Colonies for the evaporating plant designed and made by Prache and Bouillon, of Paris, claim that the evaporator which they supply approaches the ideal conditions far more closely than other apparatus of this type. Examples of these "P. and B" evaporators which have been designed for boiler feed purposes are shown in Figs. 163 and 164, but other patterns are also made for industrial processes which involve evaporation or concentration. The small plant shown in Fig. 163 is a single effect plant and is capable of producing 1 ton of chemically pure and air-free feed water per hour, whilst the equipment shown in Fig. 164 is a double effect plant and is designed to produce 6 tons of water per hour, the water being discharged at a temperature just under 100 deg. Cent.

Beyond the impellers which are provided for maintaining a positive circulation, there are no moving parts, and the apparatus works noiselessly and without vibration. The most elementary evaporator in use is similar to a tubular boiler, the tubes being filled with live steam, whilst the liquid to be evaporated is supplied to the surrounding vessel. The steam consumption, the makers of the "P and B" evaporators point out, is necessarily high, the steam produced being about equal in weight to that which is supplied to the apparatus, but the pressure is, of course, very much lower. In order to reduce the high steam consumption, the methods of multiple effect and compression and re-use of the evaporate have been evolved and are no doubt well known to our readers. The compression method has been adopted by Prache and Bouillon, and, when advisable, it is used in conjunction with the multiple effect scheme. Compression of the evaporate was apparently first suggested in the year 1830, but the difficulty of obtaining efficient mechanical or jet compressors gave rise to the preferential development of the multiple effect system. However, in conjunction with Sautter Harlé, of Paris, Prache and Bouillon studied the injector method of compression afresh, and after some years of experimental work they finally evolved the thermo compressor, which is shown in Fig. 166. Except in a few special cases, this arrangement is now fitted to all the "P and B" evaporators. Its efficiency was officially determined in 1909 by the Paris Conservatoire National des Arts et Métiers.

The efficiency of the thermo compressor is claimed to be considerably in advance of any other injector compressor and also greatly to exceed that of the piston or turbo-compressor. Comparisons of the Prache and Bouillon compressors with mechanical compressors of the above types form the subject of a paper read before the Société des Ingénieurs Civils de France in 1909 by Monsieur Jean Rey, in which it is shown that the thermo-compressor shows a gain of 30 per cent. over the piston compressor and 22 per cent. over the turbine compressor without allowing for the difference in capital charges or maintenance.

The action of the "P and B" plant will be understood from the diagram Fig. 165. Live steam is supplied to the thermo-compressor A through the pipe F, and its kinetic energy is fully utilised in revitalising steam drawn from the ebullition chamber C of the evaporator through the connection H. The revitalised mixture then passes by way of the pipe G to the heating chamber B of the evaporator, and, being there condensed, it forms the first and main portion of the pure feed supply for the boilers and is led to the common feed tank by way of the pipe J. From the diagram it will be gathered that the whole of the steam produced in the ebullition chamber C does not go to the thermo-compressor A. By means of the pipe I about one-third of the steam produced is carried to the preheater D, where, in being condensed, its latent heat is imparted to the raw cold feed water preparatory to the latter proceeding to the heating chamber of the evaporator. Any balance of uncondensed steam from the preheater is condensed in a small auxiliary distiller E and two other sources of pure feed water are therefore provided, namely, from the preheater and the auxiliary distiller condensate,

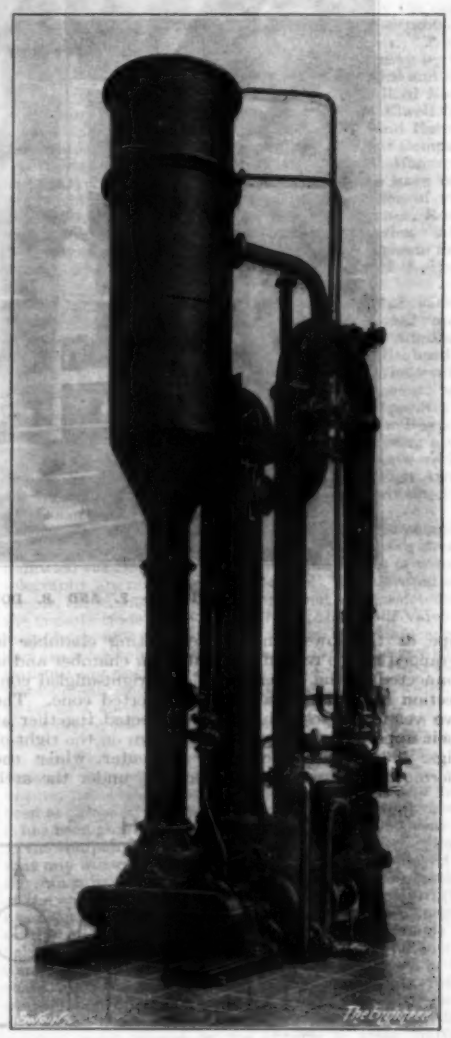


FIG. 163—SINGLE EFFECT EVAPORATOR

and on passing through the pipes K and L they join the main supply from the evaporator.

The diagram Fig. 165 relates to an actual installation that is being built and which is guaranteed to produce continuously 4 lb. of chemically pure and air-free feed water at 100 deg. Cent. per pound of live steam supplied to the evaporator, a result which is considered to be remarkable for a plant working on the single effect principle. An idea of the non-scaling properties of the plant can be gathered from the fact that the guaranteed consumption is to be measured after the evaporator has been in service for a period of three months and without any preliminary cleaning or adjustment. The means adopted for preventing deposit are positive in action and differ somewhat according to the analysis and physical nature of the raw feed water, but in all cases the makers are prepared to give equally stringent and binding guarantees, irrespective of how impure or bad the feed water may be. An installation erected at St. Gobain in

France gives a good indication of the capabilities of this class of plant, for it works continuously on the production of salt crystals from the concentrate and no stoppages are necessary for cleaning.

From the illustrations Figs. 163 and 164 and the diagram Fig. 165 the general arrangement of the evaporator plants will be understood. The ebullition chamber of the evaporator is the highest member, having an inverted cone which is connected to a down-coming

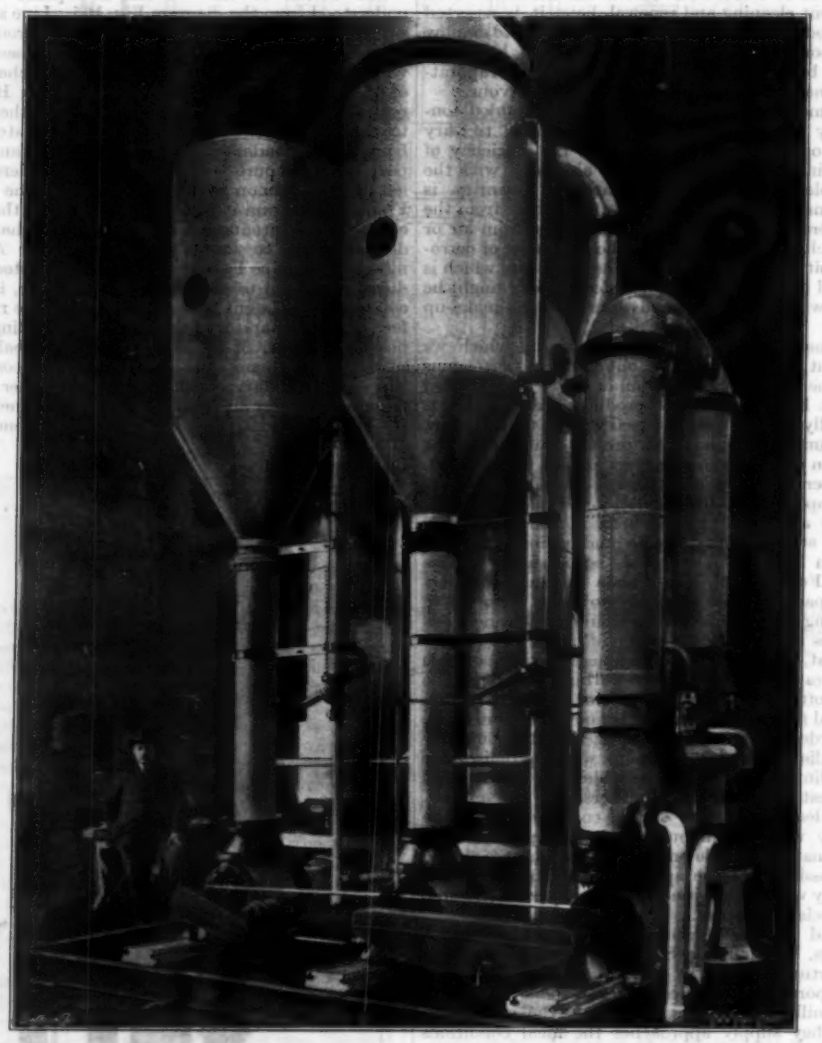
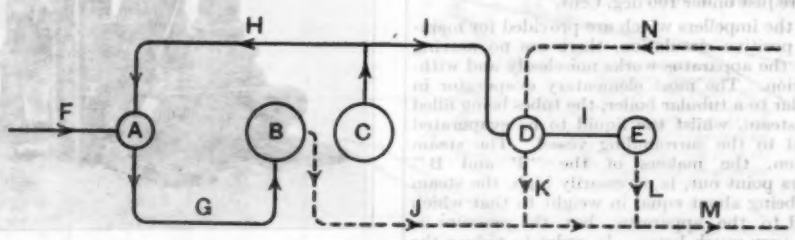


FIG. 164—P. AND B. DOUBLE EFFECT EVAPORATOR

pipe at the lower end. The heating chamber is arranged at the rear of the ebullition chamber and is connected to the latter by a large right-angled connection immediately above the inverted cone. The two vertical pipes, which are connected together at their upper ends and which are shown on the right of Figs. 163 and 164, form the preheater, whilst the thermo-compressor can just be seen under the arch



A—*Thermo Compressor.*
B—*Evaporator Heating Chamber.*
C—" *Ebullition.* "
D—*Preheater.*
E—*Auxiliary Distiller.*
F—*Live Steam to Thermo Compressor.*
G—*Revitalised Steam to Evaporator.*
H—*Low Pressure Steam to Thermo Compressor.*
I—" " " *to Preheater.*
J—*Pure Feed from Evaporator.*
K—" " " *Preheater.*
L—" " " *Auxiliary Distiller.*
M—*Total Supply for Boilers.*
N—*Raw Cold Water Supply.*

"THE ENGINEER" SWAIN Sc

FIG. 165—DIAGRAM SHOWING WORKING OF P. AND B. EVAPORATOR PLANT

formed by the preheater in the illustration of the single effect plant.

Circulation is maintained by chain-driven impellers at the lower ends of the evaporator and preheater, and provision is made for their rapid examination. The manufacturers attach great importance to the special method of circulating the steam and water, which flow in opposite directions and at a speed which is claimed to be fifteen times greater than that in other evaporators.

The tubes in the heating chamber of the evaporator have a very small diameter and are arranged vertically, and owing to the speed of the water a pressure is maintained which is just sufficiently above the corresponding temperature to prevent the formation of steam bubbles until the water passes from the top of the heating chamber into the ebullition chamber, in which the formation of steam proceeds freely. This feature is of considerable importance in the way of preserving the ideal conditions for the transmission of heat from side to side of the tubes, and is believed to account for the low temperature difference which is obtained and the consequent high thermal efficiency. The speed of the circulation is also intimately connected with the non-scaling properties of the evaporator.

In considering the installation of evaporator plant the station engineer has to examine several aspects of the problem. Where bad water is in use the prime cost of the apparatus may easily be offset by the increased evaporative capacity of the boilers without taking into account the cost of the water-treating appliances. In the case of an installation at the electricity works at Lomme, near Lille, it became possible after the Prache and Bouillon evaporators had been set to work to place 15½ per cent. of the total boiler surface in reserve under full load working conditions, and, of course, also enabled the softening plant to be put out of commission. Against the fuel, maintenance, and labour costs of the evaporators must be set the saving due to increased efficiency of the boiler heating surface, reduced cleaning, the cost of compounds, for softeners or boilers, the preservation of boilers, steam connections, &c., from corrosion and freedom from priming and water hammer. The

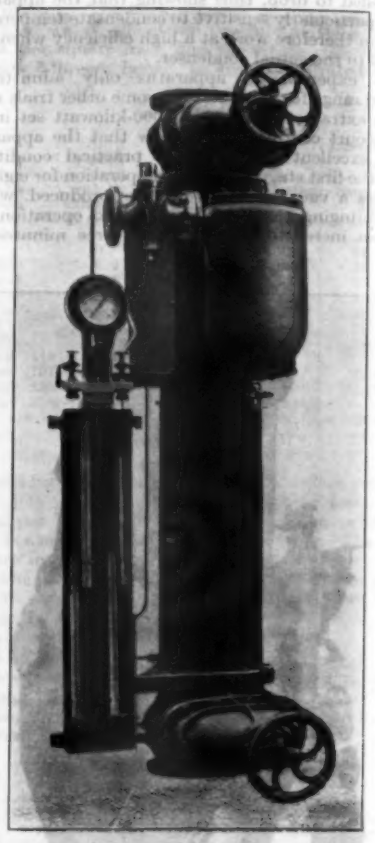


FIG. 166—THERMO COMPRESSOR

makers believe that central station engineers who look impartially into the matter from all points of view will agree that the modern evaporating plant is now an essential unit.

Imperial Wireless Communication.*

By Professor W. H. ECCLES, D.Sc., F.R.S., Vice-chairman of the Wireless Telegraphy Commission.

IN addressing the Dominions and Colonies and Indian Sections of the Royal Society of Arts on the subject of "Imperial Wireless Communication," I know that I am speaking to those who have more to do with policy than I have, and I shall, therefore, limit myself to a plain statement of the facts, which ought to be in the possession of those who wish to form their own opinion upon the proposal to erect an Imperial chain of wireless stations. These facts are mostly historical, scientific and technical, but some of them have legal and economic bearings.

Before the end of 1909, the prospect of a fight between the cable and wireless was debated everywhere, and the experience accumulated by various Governments and companies was such that the feasibility of establishing wireless communication between the parts of our scattered Empire became apparent. In March, 1910, the Marconi Company applied to the Colonial Office for permission to erect a number of large wireless stations for providing communication between the most important parts of the Empire. The matter was passed to the Cable Landing Rights Committee, and was also discussed by the Committee of Imperial Defence during 1910 and 1911. In June, 1911, the Imperial Conference passed a resolution that a State-owned wireless chain should be established, and a joint Committee was then appointed representing Government departments, Australia, New Zealand, South Africa and India. This Committee, which was called the Imperial Wireless Committee, requested the Post Office to prepare terms upon which negotiations might be opened with the Marconi Company. The terms so prepared were considered by the Cable Landing Rights Committee, who asked the Postmaster-General to enter upon the negotiations with the company.

In July, 1912, an agreement between the Postmaster-General and the company was signed under which the company was to erect forthwith stations in England, Egypt or Cyprus, Aden, Bangalore, South Africa and Singapore, and others were to follow. The stations were to be capable of maintaining uninterrupted intercommunication throughout the twenty-four hours, and were to work duplex and high speed during a portion of each day. This contract was not ratified by Parliament; a Select Committee of the House of Commons discussed it throughout the winter of 1912–13, and an Advisory Committee, presided over by Lord Parker and including several experienced engineers and scientists, discussed the technical and patent aspects of the contract. In consequence, a second contract was agreed upon between the Postmaster-General and the company, and this was ratified by the

* Abstract of paper read before the Royal Society of Arts.

House of Commons on August 8th, 1913. Work began at Leafield in March, 1914, a station in Egypt was commenced a little later, and sites were provisionally selected in East Africa, South Africa, and the Straits. But at the end of 1914, and in January, 1915, the Post Office informed the company that the Government had decided not to go on with the work, and the company thereupon intimated that they would claim compensation for breach of the contract.

Meanwhile the war was compelling attention to wireless telegraphy in every aspect. The Admiralty set up a dozen medium-power stations at well-distributed points of the Empire, the Marconi Company being the contractors. There were many new inventions and many novel applications, nearly all of them improvements of apparatus and methods existing before the war. The chief improvements were in the detail design of the audion and its associated circuits, and these improvements greatly enhanced the practicability of wireless. Its essential valuable characteristic is that it amplifies currents. In small sizes it is used for reception and enables very feeble signals to be picked up. In large sizes it is employed for magnifying the oscillation already started in a circuit and so sustaining it. This is done by taking a portion of the existing oscillation, feeding it to the input side of the triode valve, and adding the magnified result to the original oscillation, all in a continuous manner. The energy is supplied from a direct-current battery, and the magnifying process goes on until a certain limit is attained determined by the sizes of the battery, the triode valve, and other parts of the apparatus. This feed back method of strengthening and sustaining oscillations was invented by Armstrong in America and by Meisaner in Germany independently in the spring of 1913. It enables the triode valve to be used not only as a rectifier and an amplifier, but also as a converter of direct current into current oscillating at any desired frequency.

The war greatly accelerated the development of these pre-war inventions, and nowhere was progress more rapid than in the radio-telegraphic laboratory of the French Army. Here, under the guidance of General Ferrié, the valve, or lamp, as the French call it, was pushed to perfection in the construction of amplifiers and other apparatus for the reception of signals. The apparatus in use to-day for these purposes remains much the same as at the date of the Armistice. The basic inventions of Marconi, Lodge and Poulsen have become more and more valuable in consequence of improvements brought about by the triode valve.

Meanwhile, although work on our Imperial chain has been suspended, America, France, Germany and Italy found it necessary to press on during the war with their corresponding schemes. As it stands now, the American Navy's strategic and partly commercial chain comprises six first-class stations and a larger number of second-class stations. The first-class stations link Washington with Central America and California, and through Honolulu and Guam, with the Philippines. The terminal station has a 500-kilowatt arc, and is less than 2000 miles from Peking, Tokyo, India, and Northern Australia. Most of the steps of the Pacific chain are of the 2000-mile order, but there is one big step of 4000 miles, from Honolulu to Guam.

The French military chain is now nearly completed, much of it having been planned since the Armistice. Paris is, or will shortly be, linked by first-class stations with the Soudan, the Congo, Antananarivo, Pondicherry and Cochin China. All these steps are of the 2000-mile order, except that from Antananarivo to Pondicherry, which is 3100 miles. Besides the military chain, France possesses a first-class naval station at Nantes, and two magnificent stations at Bordeaux and Lyons, controlled by the Department of Posts and Telegraphs.

The Italian State-owned scheme embraces two stations in Italy, and two spark ones in North-East Africa. The Rome station was built by Mr. Elwell during the war, and the Coltano station is being equipped by the Marconi Company. The largest distance between the Italian stations is about 2500 miles. The German chain contemplated three stations in Africa, one in the Java seas, and one in Yap. Those which were erected were lost during the war. The distance from the Nauen station to the Kamina station is 3400 miles, and proved too great for real work. Windhuk is nearly 2000 miles south of Kamina, and is believed to have exchanged scarcely any signals successfully during its short active life.

At the time these various wireless networks were being laid down or completed by foreign Governments, the British Post Office obtained a grant of £170,000 for equipping the Leafield and Cairo stations, abandoned in the first year of the war, and the Marconi Company brought their long-deferred action for damages for breach of contract, and went before Mr. Justice A. T. Lawrence with the petition of right. The arbitrator awarded, in July, 1919, the sum of £590,000 to the company, as his estimate of the present worth of all the royalties which the company would have received under the contract.

The Government now decided to take up again the problem of the Imperial chain. They had the advice of the Parker Committee before them, of date 1913, and there was the experience of the war and of other countries. The Parker report stated that the Marconi Company were, in 1913, the only firm doing business in this country able to erect at once stations of the necessary magnitude; but it added some comments which probably influenced later decisions. The report (paragraph 9) points out that in order to get the best results, it would probably be desirable to "combine apparatus, the combination of which is difficult, if not impossible, because of the existence of patent rights." A famous example of this mode of operation of the patent system is seen in Watt's "Sun and planet motion," and there are innumerable others. The Crown, however, cannot be prevented from using any patent. This is an advantage of State ownership, arising out of purely technical considerations, and is perhaps to be regarded as worthy to rank with the political and strategical advantages envisaged by the Committee of Imperial Defence.

But in order to obtain up-to-date advice, Lord Milner, as chairman of the Imperial Communications Committee, and with the approval of the Cabinet, appointed, in November, 1919, a Committee, under the chairmanship of Sir Henry Norman, to consider afresh the problem of establishing an Imperial chain of wireless stations. The terms of reference instructed the Committee to consider both strategical and commercial requirements, and to make estimates of costs and of revenue under any scheme they proposed.

The merely physical problems confronting the Committee may best be described by aid of an analogy. Suppose that a proposal was made to establish telegraphic communication between Hampstead Heath and the Crystal Palace by means of beams of light sent across London. We know that on a dark night, with a clear atmosphere, the rays of a single candle would be sufficient to carry signals from either station to the other. But when a thick brown fog hung over the City, on a December morning, it would be impossible to pass a signal even by aid of millions of candle-power. There are all grades of capacity between these extremes, and, in fact, the candle-power found just sufficient for telegraphy would be different each day. Now, it would be quite true to say of this particular method of signalling between these points that communication was possible with, say, 200 candle-power; but everyone knows that at certain seasons there would be good signals only for an hour or two per day, at other seasons for many hours per day, and on rare occasions, a good telegraphic service might be maintained throughout the twenty-four hours. In order to increase the average number of useful daily hours per annum, the most natural step would be to set up a relay station—say, on the dome of St. Paul's. The same candle-power will pass more messages through the half-distance than through the whole distance, and the service would, therefore, be more continuous. The central relay station, besides, would be able to seize opportunities of any clear intervals that might arise to the north or south of it. The erratic way in which these clear intervals occur in a misty or foggy atmosphere is familiar to every Londoner, and it will be admitted that an even better service, reckoned by the average annual hours of effective communication, would be afforded by having more than one intermediate relay station.

All this is but a paraphrase of what occurs on the grand scale in wireless telegraphy. Instead of miles we must speak of thousands of miles; instead of patches of fog over parishes, we must think in countries, oceans and even continents. Instead of the smoky vapours of the Thames, we think of electrical fogs extending into the highest atmosphere; fogs that may gather and disperse just as rapidly as the London mists; fogs that have daily and yearly variations as unaccountable as the weather itself.

At this point, the analogy must be dispensed with, because there are other electrical difficulties not analogous to the meteorological ones I have just described. For whenever electricity gathers in the atmosphere, electrical discharges from one portion of air to another, or to the earth, are continually taking place, and these generate natural electric waves that course over the earth, agitate the receiving apparatus of wireless stations, and produce noises in the telephone of the operator or marks on the tape of the recorder which mask or overwhelm the man-made signals. These disturbances, due to natural electric discharges, are spoken of as "X's" or "strays" or "atmospherics." In these circumstances it is of little use to employ powerful magnifiers of the signals enfeebled by passing through thousands of miles of electrical fog—for the true and the false signals are magnified together. The only hope is to discover and apply methods of discriminating between the true and the false; such methods are being slowly evolved.

The Committee had these considerations before them and studied the views of many people of experience in these matters. They concluded that if, for example, direct communication were attempted between England and Australia, there could be only a few hours of good service per day on the average, and that the owners of the stations would then call for the erection of an intermediate station in India in order to employ their capital to better advantage. A group of five big stations, namely, England, Vancouver, Australia, South Africa and India, offers a better scheme, but is open to similar objections—that is to say, the annual average of hours of service might be too low to be remunerative, especially if, as must needs be, the stations erected were to be of the largest possible dimensions. The next step is obviously to introduce intermediate relay stations between the big five and to install at all places first-class stations of great but not extreme magnitude. Spent in this way the same money would give, the Committee believed, a more efficient and in the end more speedy service between the principal centres, would bring the communities at the intermediate places into touch with the rest of the Empire, and would more assuredly satisfy the Admiralty's and the other strategical requirements. This distribution of the stations happens to be geographically possible in the case of the British Empire without exceeding 2800 miles in any step, the average step being about 2400 miles. This has become known as the 2000-mile scheme. It happens to coincide with the length of the step aimed at in the American, French and Italian schemes, though some of these were perhaps settled upon later.

But in order to ensure uninterrupted service over distances ranging from 2000 to 2800 miles at bad times of the day and year the stations would have to be very powerful. After collecting evidence of what was likely to be practicable within a few years, they decided to recommend that the stations be designed to deliver 240 kilowatts to a low resistance aerial of great height. If the art had not sufficiently developed by the time erection was in progress, the stations should be built of 120 kilowatts power, and be made capable of early enlargement to the full power. They recommended that the triode valve method of generation of oscillations should be employed, if sufficiently developed. If I may say so, this was a very bold move on the part of the Committee, for the largest known valve station in existence at that date was probably less than 20 kilowatts in magnitude.

With such stations, the Committee pointed out in their report each centre would be able to communicate during certain hours of the day with the most distant of its fellow stations; and they expected that by aid of the intermediate stations any two of the centres could get into communication quickly at any time of the day or year. On this point, perhaps, the Committee were a little oversanguine—there will be occasional hours, I imagine, when even the more powerful stations will fail to force good signals across 2400 miles.

The chain of stations as finally recommended by the Committee for immediate erection consisted of stations in England, Egypt, India, Singapore, Hong Kong, Northern or Western Australia, East Africa and in South Africa. The stations in England and in Egypt are to be of the new type and additional to Post Office stations at Leafield and Cairo. There are thus two branches, an African and an Eastern, meeting in Egypt. The case of Canada was postponed for joint consideration with representatives of the Canadian Government, stations at Montreal and Vancouver being provisionally suggested. In actual operation, messages from England to Australia would pass through all the intervening relay stations during the intervals of greatest atmospheric opacity and disturbance, being handled in much the same way as at cable relay stations. During clear intervals one or more of the relay stations would be omitted. Wireless here possesses great advantages over the cable.

The Committee recommended that the Post Office Engineering Department in this country and the corresponding Departments overseas be given responsibility for making contracts with private engineering firms and supervising construction, and further recommended that a small Commission be appointed for planning the stations and advising generally during erection. This, by the way, is in close accord with the principles enunciated by Lord Parker's Committee of 1913, in their valuable report.

The chief anxiety of the Commission during the past year has been to determine whether or not the equipping and running of triode valve stations of 120 and 240 kilowatts is a practical proposition from every point of view. They have been almost satisfied by witnessing the independent development work of Signal School and of the Marconi Company. There was sufficient doubt left as regards annual running costs to lead the Commission to recommend that arc stations be temporarily installed in the Nairobi, Singapore and Hong Kong stations, to be converted later to valve stations when these had been proved out in less remote places.

The Commission have had to survey broadly the capability of the industry to meet promptly the probable demands during construction and afterwards. Triode valves in glass can be supplied in ample quantity by the Marconi Osram Valve Company; valves in silica and also in glass can be supplied similarly by the Mullard Radio Valve Company. As regards tall masts, the Elwell firm have erected some of the tallest in America and Europe. As regards general wireless plant the Marconi Company have obtained modern experience of large station work at Carnarvon and Coltano; the Elwell group have been responsible for the construction and installation of vital parts of the big stations at Paris, Lyons, Nantes, Rome, Leafield, and Cairo, as well as several in America. Altogether there is a great body of experience in private firms available for contributing to the construction of the chain stations.

Over and above this, the scientific staff of various Departments of the Government have gained much experience during the war and since. The Admiralty Signal School, Portsmouth, is, I believe, well ahead of any firm in the applications of the large silica triode valve. The Army, at Signal Experimental Establishment, have developed a type of high-speed receiving apparatus of unsurpassed efficiency. The Post Office, in their Research Laboratory, have devised and developed receiving apparatus which has won the admiration of all who have worked with it in this country, in Egypt, India and East Africa. All these improvements are, I understand, protected by patents of which the Crown has free user.

No discussion of the Imperial chain would be complete without a reference to the patent situation. I have already indicated that many of the fundamental things of wireless telegraphy are now free for all to use. The elevated conductor, the tuning coil, the arc converter, various detectors, the two-electrode valve for rectifying, the triode valve for magnifying and others, are as free as the steam engine and are relatively as useful. For example, the great new transmitting station near Bordeaux, owned by the French Government, and perhaps the greatest in the world, is, so far as I am aware, quite free from patents. All the transmitting stations of the American chain appear to be similarly free. On the other hand, some, but not all, of the Imperial chain transmitting stations will employ the Meissner feed-back invention described earlier in this lecture, but I am instructed that the rights of this have been acquired by the Marconi Company, and that user of it has been paid for by the Crown in the £500,000 awarded to the company by Mr. Justice Lawrence. I do not know that any other patent of significance will be employed by the transmitting stations. As regards the receiving stations of the chain, the Meissner patent is again employed (but has been paid for), and the heterodyne patents belonging to the Metropolitan-Vickers Company may possibly be held to be concerned. There are two early patents of German origin which may possibly be employed in the chain stations, one for amplifying oscillations before transmission, and another for amplifying the feeble oscillations dealt with in reception; but neither of these is given much weight by the experts in these matters. No other patents of the last class and of outstanding fundamental importance appear to be employed.

THE value of the output of minerals in New South Wales last year is officially estimated at £14,018,648, representing an increase of £2,607,186, compared with the previous year. This advance is due almost wholly to the increase in the value of the coal produced, and to the fact that towards the end of the year the Broken Hill mines partially resumed operations. In 1918 the value of minerals was £14,419,352, and that was the only year in which last year's figures have been exceeded. During the year 29,701 persons were employed at the mines, an increase of 538. The coal hewn is given at 10,793,387 tons, a record for Australia, being 77,388 tons more than in the previous year. The output at the pit mouth was valued at £9,078,388, an increase of £1,355,033. The gold yield increased by 2266 oz. fine and £9624 in value to 51,173 oz. fine, valued at £217,570. Products of silver-lead mines reached £1,610,819, an increase of £1,237,882. The copper output declined by £86,711 to £41,267, and tin by £250,343 to £163,451.

Alcohol for Internal Combustion Engines.

IT was decided by the Empire Motor Fuels Committee that a comprehensive and complete scientific investigation should be made of the behaviour of alcohol in internal combustion engines, and that a complete range of experiments should be carried out with 95 volumes per cent. alcohol, as this was the strongest alcohol produced in commerce by the patent still. Through the kindness of the Anglo-Asiatic Petroleum Company the Committee was allowed to make use of the Ricardo variable compression engine which had been designed and built for that company. The Government authorities gave permission for the experiments to be carried out with pure alcohol, so that there should be no difficulties introduced in this fundamental work by the presence of denaturants. In these and all other tests the Committee has readily obtained the willing co-operation of the Government Departments concerned.

The experiments which it was decided to carry out with 95 volumes per cent. alcohol were divided into four series :—

Series 1.—Tests for power output and consumption over the complete available range of mixture strength with open throttle at four different piston speeds from 800ft. to 2000ft. per minute, and at compression ratios of 3.8 to 1 and 7 to 1 with constant heat to the carburetter.

Series 2.—Tests of power and efficiency over complete range of mixture strength at 0.8, 0.6 and 0.4 of full load with piston speeds of 1200ft. and 2000ft. per minute and a compression ratio of 5 to 1, with constant heat to the carburetter.

Series 3.—Tests over complete range of mixture strength at piston speed 2000ft. per minute, compression ratio 5 to 1, constant heat to carburetter, but with the circulating water at the outlet varied from 30 deg. to 90 deg. Cent.

Series 4.—Tests over the complete range of mixture strength at 2000ft. per minute piston speed, at a compression of 5 to 1, varying the heat input to the carburetter from nil to 2000 watts.

This work has entailed many thousands of readings, but the results are of the greatest value.

It was found that at all speeds both with high and low compression the thermal efficiency obtained with alcohol was higher than that obtainable with petrol or benzol at any compression which could be employed with them. Even at the low compression of 3.8 to 1, the thermal efficiency with alcohol is substantially greater than that obtained with petrol under similar conditions. In both cases the efficiency is almost independent of speed. The heat delivered to the circulating water is less in proportion with alcohol than with petrol. It was further found that compared with petrol or benzol the thermal efficiency obtained with alcohol was equally high at high or low compression. The tendency to pre-ignition began to be evident at 7 to 1 compression ratio.

Owing to the lower heat value of alcohol, the fuel consumption is much higher than is the case with petrol, in spite of the higher thermal efficiency, if they are used at the same compression, but the fuel consumption can be reduced much further in the case of alcohol than in the case of petrol by increase of compression ratio. The throttle tests (Series 2) have shown that the behaviour of alcohol and petrol under variations of throttle conditions was identical.

The influence of jacket water temperature was investigated (Series 3), and showed that the power output from the engine was slightly diminished with increasing jacket temperature. The efficiency also fell slightly, as is the case with all other volatile fuels investigated. The reputed increased power obtainable with alcohol engines with hot water jacket is probably much more due to the diminished piston friction in the warm cylinder than to any other cause.

The experiments in Series 4 have shown that the maximum output from the engine is obtained when no heat is supplied to the ingoing air, but the thermal efficiency is slightly increased with increase of heat to the carburetter.

It has been proved that under all conditions of compression speed or throttle alcohol-driven engines run more sweetly and more smoothly than when running on petrol. Detonation never occurred under any compression employed, but at 7 to 1 compression, corresponding to a pressure of 185 lb. per square inch, there was a tendency to pre-ignition ; 6½ to 1 is probably the maximum compression to be aimed for.

There has been no evidence whatever of any corrosion of valves.

It must be remembered that these experiments have been carried out on a single-cylinder engine, and that in practice troubles and difficulties introduced by induction manifolds may render it desirable to sacrifice efficiency in some directions to gain flexibility and acceleration. Nevertheless, the series of experiments which have been carried out have led to the accumulation of the most valuable fundamental facts and figures which must be of the greatest value to the industry in the near future. It was decided by the Committee that further experiments should be carried out on similar lines to those above referred to, but with alcohol at 99 and 90 volumes per cent. strength. The results obtained with these fuels substantiated the earlier work and proved that the mean effective pressure increases as the water content is increased, so long as the whole of the fuel and water is completely evaporated before the end of the compression stroke. The power output was increased slightly even with the 90 volumes per cent. alcohol. The behaviour of the varying amounts of water was studied over compressions ranging from 3.8 to 1 to 7 to 1, and it was proved that the presence of water in all cases increases the maximum power output and reduces the heat flow through the cylinder walls. In high compression engines there is a substantial advantage in using alcohol containing a reasonable amount of water.

It has definitely been proved :—

(1) that alcohol can be used from the low compression employed on paraffin engines up to a far higher compression than can be used on any petrol engine ;

(2) that the thermal efficiency obtainable with alcohol is higher than with petrol or benzol ;

(3) that under all conditions of throttle or mixture alcohol requires the spark more advanced than is the case with petrol or benzol, and much more advanced with weak mixtures ;

(4) that there was no evidence at any piston speed attained in the engine that the rate of combustion of alcohol under the conditions obtaining was too slow to obtain the maximum effect ;

(5) that detonation does not occur at compressions up to 8 to 1, and pre-ignition does not occur at 6 to 1, even when running for long periods at the highest possible power output of the engine ;

(6) that there was no evidence whatever of corrosion in the engine ;

(7) that the power output and efficiency are increased by low temperature of the circulating water ;

(8) that supplying heat to the carburetter reduced the power output but slightly increases the thermal efficiency ;

(9) that increase in the water content up to 10 volumes per cent. is an advantage, particularly in very high compression engines.

A new series of experiments is now in hand with a view to investigating the influence of ether on alcohol, and the influence of alcohol on petrol, benzol, paraffin, and the like. It is believed that this work will prove of considerable value to the motor industry, as it is probable that the first introduction of alcohol on any scale as a motor fuel will be in the form of an admixture of it with other ingredients.

SUFFICIENCY OF BRITISH PATENTS.

ONE of the objections usually raised in patent actions by the defendants against the validity of the patent in suit is that the description is insufficient, or, in other words, does not fully disclose how to effect what the specification indicates is the result of the invention. Two important cases have been decided within recent times in which this matter became of very material importance. The first is that relating to the so-called half-watt lamp patent, subsequently upheld in the House of Lords after adverse decisions in the two lower courts, and the second relating to the removing of esparto from stationary digesters in the papermaking industry. This action has proceeded up to the present as far as the Inner House in the Court of Session in Scotland, according to the current reports of patent cases. The merits of the actions do not come into question here at all. All that it is necessary to point out is that considerable litigation was involved owing to the suggestion that the specifications were not adequate. The public is entitled at the end of the term of a patent to be able to carry the invention into effect without further invention from the description given in the specification, and it is therefore imperative that inventors shall give such a description in their specification as will enable this to be done.

The kind of difficulty that might be met is well shown in the report on the esparto case. Here it is stated that it was averred by the defenders that the method disclosed by the specification would not work, and that the directions given were insufficient. Generally speaking, the patent related to "a method of and means for removing the digested material from digesters by subjecting this material to the action of a stream or streams of water so as to disintegrate and wash out the same. An arrangement of nozzle or nozzles was provided in suitable positions in the digesters and supplied with pressure water from a main pipe by means of a valve-controlled pipe connection and a valve-controlled discharge pipe. It was proved that the general result claimed could be attained, if the digester were partially flooded and jets of pressure water were directed alternately from the separate nozzles through the discharge opening of the digester. There were no instructions in the specification to flood the digester or to use the jets alternately, and it had been assumed for a time by the pursuers' witnesses that the jets were to be operated in an unflooded digester. The pursuers adduced evidence to show that the nozzle shown diagrammatically in the top digester was intended to be movable, and the defenders adduced evidence that it was intended to be fixed." It was held by the Lord Ordinary (Lord Blackburn) (1) that the application of jets of water to disintegrate and wash out boiled esparto from digesters was ingenious and proper subject matter for a patent, and that it was novel and useful ; but (2) that the patent was bad in respect that the method of using the jets through the discharge opening of the digester was not sufficiently described, and called for the exercise of considerable ingenuity in order to discover how it should be worked.

CONTROL OF THE WATERS OF THE LAKE OF GENEVA.

THE Paris *Journée Industrielle* learns from Geneva that a conference dealing with the control of the waters of the Lake of Geneva having been arranged for this spring between the Confederation and the cantons, negotiations may shortly be resumed with France touching the development of the navigable way of the Rhone between Marseilles and Geneva. Three projects have been submitted in this connection, each of which involves the piercing of a tunnel under the right bank. The Narutowicz plan put forward by the town of Geneva provides for the increase of the maximum carrying-off capacity of the outlet from 600 cubic metres per second to 1200 cubic metres per second, thus reaching the normal contribution in flood time of the streams flowing into the lake. The experts Collet, Imbeaux, Narutowicz and Schatti have planned a tunnel in three parts, the two lower serving to draw off flood water, and the upper being used for navigation and, exceptionally, for the evacuation of extraordinary floods. The experts Bernouillo, Van Bogaert, Luchinger and Sabouret propose one tunnel for navigation and another to drain off water.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

The Trade Position.

THE more hopeful outlook in the iron and steel trades of the Midlands continues, and, happily, the latest developments in the industrial dispute have not affected materially this branch of local trade. There is, of course, the keenest anxiety for a general settlement, for it is considered probable that its achievement would result in a large volume of business, now held up, coming into the market. The figures received in Birmingham are regarded as entirely encouraging, and show a steady improvement in American trade. Pig iron output in the United States has nearly trebled since last July, while steel production is up to 70 per cent. of capacity. Railways are placing large orders, and constructional engineers are full of work. This, it is inferred, must relieve the strain of international competition, and is considered partially accountable for the steady increase here of foreign inquiry. Midland ironmasters are, however, considerably perturbed about the question of railway rates. Great dissatisfaction is expressed over the refusal of the railway companies to announce their transport rate revisions until the end of the engineers' lock-out. It is believed here that if the railway authorities would at once outline their policy some business now being held over would be promptly placed. It is stated further that this district has lost, through high railway rates, valuable export orders for pig iron. In a recent interview Mr. F. J. Blakemore, president of the National Chamber of Trade, predicted a wonderful trade revival at an early date. He declared that Britain was becoming increasingly successful in the world's competition, and while German manufacturing costs were increasing, Britain's were falling. He believed the time had arrived when the cost of production of manufactured goods in this country had been reduced to such a limit that we were becoming successful competitors in the world's markets. He emphasised the necessity for an early settlement of industrial disputes.

Birmingham Brass Trade Improvement.

There is an improved tendency in the Birmingham brass trade. Demand at home is increasing, and some of the overseas markets are ordering on rather less meagre lines. The gradual improvement which is coming over the building trade is principally responsible for the increased business, though orders in connection with shipbuilding and the refitting of old ships have been of greater value recently. The orders which are reaching the brass foundries here are chiefly from Belfast, where, in spite of political distractions, considerable contracts are being carried through. A certain amount of business is coming to hand from the Continent, as our own prices approximate more nearly to those of Germany. It is, however, on the home market that expectations mainly centre so far as the immediate future is concerned. Happily, thus far the brass industry of this district has not been much interfered with by the lock-out in the engineering trade. Indeed, since the dispute began nearly two months ago the working hours have been progressingly extended at many of the Birmingham and Black Country factories. The foundries are beginning to feel some dislocation now in certain directions, but not enough to outweigh the increased activity in other departments.

Pig Iron in Demand.

Quite a lot of encouraging business has been done this week in pig iron. Local merchants have executed some good export orders. The pig iron industry continues to benefit from the maintenance of exports, the latest records showing no less than 44,138 tons sent away from Middlesbrough during April, of which over 11,000 tons were dispatched to Germany. The amount of inquiry for pig iron during the past week in the district has been quite remarkable considering the adverse circumstances. Inquiries for 1000-ton lots are reported in some merchant offices and at the headquarters of pig-making concerns. A proportion of this iron is wanted for America, following the very large expansion of business there, which is to some extent hindered by the coal strike ; and, in fact, a good deal of pig iron and coal have been shipped from this country to help the Americans over their difficulties. Some of the inquiry on foreign account has found its way to Midland firms, including Far Eastern business originating in Japan. This district, however, is not well situated for export, owing to the heavy railway rates. The demand has, however, strengthened the claim for reduced railway rates. Pig iron prices are unchanged, recent quotations being well maintained. This fact appears to account for the interest taken in the market even by engineering firms, troubled as they are by the lock-out. An additional furnace has been blown in in the Northampton district.

Cheaper Nut and Bolt and Fencing Iron.

There is no improvement discernible in the manufactured iron trade of the Midlands, with the exception of that branch which caters for the requirements of nut and bolt makers. Orders are few and of small dimensions, and manufacturers are experiencing some difficulty in carrying on. Marked bars remain at the £13 10s. basis. Some very low prices are mentioned for merchant bars, but whatever reality they have, the slump which they suggest does not apply generally. At £11 Crown bars do not appear to be attractive to buyers, and little business is passing. The improvement in the demand for nut and bolt quality iron continues, and hopes are entertained that now that the shipbuilding dispute has been settled further improvement may be experienced. The competition for the nut and bolt trade continues to force down prices of bars applicable to that branch. There has been a further fall of 2s. 6d. this week, bringing the price down to £10 2s. 6d. Apparently there is not much foreign competition, though Belgian firms continue to quote £9 0s. delivered Darlaston. However, this does not prevent the sale of iron by local

makers at £10 2s. 6d. Fencing iron has also depreciated half-a-crown, being now quoted at £10 5s. Business has been done in heavy wrought iron scrap at £3 per ton loaded in trucks in the district. Sellers, however, are dissatisfied with this price, and generally press for £3 5s. The makers of galvanised sheets have found it necessary to accept £16 5s., the quotation of £16 10s. last week not having led to business. So the second attempt of makers to force the price upwards has had to be abandoned, though with much reluctance, as present prices are stated to be unremunerative. Black sheets are commanding about £11. This is a figure well below continental quotations.

Business in Steel

Steel business is not quite so brisk this week, but prices remain firm, and at some works show a stiffening tendency. Particularly is this the case among firms outside the Association. As indicating that there are orders about in some branches of the steel trade, I may state that Walter Somers, Limited, of Halesowen, East Worcestershire, have just been able to make a re-start at their Haywood Steel Works, where some of the departments have been idle for nearly a twelvemonth past. Messrs. Somers' output consists mainly of marine shafts and cranks and other heavy engineering forgings of a similar description, and it is because they have recently secured some new orders in this line that they have been enabled to resume operations in this particular department. The whole of the works have not yet got back into activity, but a start has been made, and hopes are entertained that it may be possible to continue the re-employment of the labour which has been begun. A little improvement is also reported in constructional engineering, emanating largely from municipalities. Manchester, for instance, has been largely in the market with orders for four bridges required in connection with a road improvement scheme. Some big orders for cast iron and steel pipes for water undertakings, &c., are also on offer. With regard to steel itself, the prices of steel plates and sections remain unaltered. Common steel strip can be bought at £10 5s., and steel bars at £9 5s., though some local quotations are considerably higher. The Welsh mills are meeting with more success in their attempts to establish £7 15s. as the price for steel sheet bars delivered outside their home radius. That figure is now generally quoted, though supplies are stated to be still obtainable at £7 12s. 6d. in special cases.

Wire Prices Reduced.

Wire prices have this week been reduced by from £1 10s. to £1 per ton, according to their character. Mild steel wire in catch-weight coils has fallen by £1 10s. per ton, making the basis for bright £16 10s. for sizes to 8 gauge. There have been corresponding reductions in other finishes, and reductions of roughly £1 per ton on all mild steel wires cut to length.

The Lock-out.

The situation in the Birmingham, Coventry and Midland district generally as regards the engineering dispute remains practically unchanged. At Coventry, however, it is reported that more men have gone into the works than was the case last week.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

Iron and Steel.

THE failure to come to any settlement in the engineering dispute continues to exercise a very depressing influence on all the markets in this district. The loss of the district in general buying power is alone very serious, and is affecting not only the metal trades but all the industry of Lancashire, and the continual disappointment of hopes raised by some particular phase in the negotiations produces a very bad effect. There is, of course, a certain amount of business going on, and one comes across merchants and makers who have been doing exceptionally well, and from them one gets the impression that things are not so very bad; but if a general survey of the position is made it becomes clear that those who are getting business are in a minority, and that, taken as a whole, the iron and metal trades are about as depressed as they well can be. There is still a very prevalent belief that important business is being held back only and that a rush will come when the labour dispute is settled; but unless it is now settled quickly a good deal of that business will almost certainly fail to materialise. The country is not in a condition to stand the effect of these prolonged stoppages.

Metals.

The general opinion here about copper is fairly favourable to the future prospect of market prices. Both merchants and consumers have more confidence than formerly in the essential soundness of present values; and it would only need a general return to work to bring about considerable buying. The growing cheapness of money, as indicated by the discount rates and the course of gilt-edged securities, would probably be an important factor in the matter of building up stocks of copper against the probable consumption of the second half of the year. If the consuming trades began to hold reserves of copper, under the belief that any change in prices was likely to be upward, copper producers would soon feel the relief and be able to ask for more money. Some movement of this kind does not seem improbable when once the labour troubles are out of the way. The American market appears to be rather firmer than it was, and consumption there is better, and may probably improve if producers take care not to advance the prices too rapidly. Here, of course, business is on a small scale, but it is reported that scrap copper is getting less plentiful. The excessive quantities of scrap gun-metal and brass, however, tend to reduce the consumption of new copper. The price of sheet copper is now more moderate, and more in accordance with standard and refined copper; but there is still plenty of margin for a reduction in locomotive tubes, both copper and brass, and particularly in brass condenser tubes. Yellow metal rods are fairly reasonable at 6¼d. per pound. Tin has been slightly easier, but perhaps the advance which began early in April went a little too fast. The question is whether the present rate of consumption is equal to dealing with the new metal which is coming forward. Some people say that this is the case, and if so, the statistical position may gradually improve, so long as the Eastern reserves are firmly held. In any case the market does not seem to be in a dangerous position at present. The demand for lead seems to have slackened a little, and there have been some large arrivals. The Australian arrivals will slacken off soon, but it is possible that these may be replaced by sales from America. In any case there is not much apparent reason why the price of lead should go any higher. Spelter has been quite a firm market round about £27. In the trade this is said to be high enough, but it is still a very moderate price compared with lead. English makers are not contributing much to the general supply, but a little spelter is now coming in from Belgium.

Pig Iron.

The position here in the foundry iron market does not show any particular change. The makers of Midland iron do not admit that it will be possible to reduce the prices even if it should happen that selling of iron in the district should stop completely, but buyers are not nearly so sure on this point, and very few are inclined to buy foundry iron until they see an opportunity of using it. It is now reported that the export demand for Cleveland pig iron is falling away, and one has to consider what will be the effect on Midland iron prices if the Cleveland makers are compelled to seek a market again in Lancashire. At present the furnace price of Cleveland No. 3 stands at about 10s. per ton above the Midland price for a similar quality of iron; but this is a totally unnatural position, and it cannot be supposed to be permanent. In the end, of course, Cleveland iron will stand at the same furnace price as Midland iron, or perhaps a little less, as used almost invariably to be the case. The question is whether, supposing the foreign demand fails to keep the Cleveland ironmasters employed, they will blow out furnaces or put down the price. The condition of the market here is mainly governed by the engineers' lock-out. It is some satisfaction to know that the shipbuilders are going back to the yards, but this does not affect the Manchester market, except indirectly; and the opinion here now is that the engineering stoppage is likely to last much longer. Many of the ironfoundries in this district are idle, and those which are working have only a little to do. It is likely that a sharp change would come over the local foundry iron market if the engineering shops were opened; but one doubts very much whether the effect on the prices would be more than temporary.

Finished Material.

There is a small trade still going on here in finished iron and steel, but it is for moderate-sized lots and the aggregate of the orders is not satisfactory. For small orders the official prices seem to be paid, but there is a belief that large orders could be placed at less, although no change has yet been made in the official Association prices.

Scrap.

Dealers in scrap report a very much diminished inquiry. Steel scrap can scarcely be sold here at a price which will pay for the trouble of dealing with it. For heavy wrought scrap the price given at the ironworks is still £3 per ton. Foundries are, of course, buying very little cast scrap, but dealers here still quote 80s. per ton for ordinary broken machinery castings, and up to 90s. for "textile" cast scrap.

Institution of Electrical Engineers, N.W. Centre.

The annual general meeting of the North-Western Centre of the Institution of Electrical Engineers was held recently at the Engineers' Club, Manchester, when the report of the Committee on the past year's proceedings was adopted. According to the report, the membership of the Centre shows a considerable increase. It now amounts to 1343, including 152 members, 558 associate members, 20 associates, 116 graduates, and 497 students, an increase of 129 over the previous year. Eleven ordinary general meetings of the Centre and two special public meetings were held during the session. The average attendance at the ordinary meetings was 115, an increase on previous years' records. As a result of the nominations and ballot at the annual general meeting the following were elected to take office in September next:—Chairman, Mr. A. S. Barnard; Vice-chairmen, Messrs. G. A. Juhlin and H. C. Lamb; Hon. Secretary, Mr. W. A. Coates; new members of Committee, Messrs. A. G. Ellis, A. B. Mallinson, W. J. Medlyn, and S. L. Pearce. The Liverpool sub-centre, founded in 1919, continues, the report states, to make good progress. The membership is now 449, and the students' section is now firmly re-established after the break due to the war. Much of the success which attended the meetings last session was undoubtedly due to the very live interest taken by the chairman, Mr. W. Walker, in all that appertains to the Institution. Under his chairmanship discussion has been stimulated and the number of speakers has shown an increase. A feature of the year's affairs was the joint meetings arranged by the Committee with the Institution of Heating and Ventilating Engineers and the Manchester Association of Engineers. These meetings were well attended, as were also the public lectures on "Switches" and "Atomic Research."

The Lock-out.

There is little or no change to report in connection with the lock-out in the engineering trades of this district. The Government inquiry ended as most engineers anticipated, and there appears to be no chance of an immediate settlement. The principle for which the employers are contending is one which they say will not stand "whittling" down, and is recognised by the majority of the men as necessary for the conduct of trade. Generally there is not much to complain of regarding the conduct of the men, but cases of wilful obstruction and interference with apprentices and staff at Broadheath which are not creditable to trade union methods have come to my knowledge, although those responsible are very careful not to commit actual violation of the laws.

BARROW-IN-FURNESS, Thursday.

Pig Iron.

There is nothing fresh to report about the hematite pig iron trade. It is still affected by the engineering lock-out, and will continue to be under a cloud until all the troubles are settled. But for this disturbance the business in mixed Bessemer numbers would have been considerable by now. As soon as there is a clear view ahead it is anticipated that there will be considerable activity; not a sudden boom, but a solid and substantial improvement from week to week. The prices at present are right and low enough to tempt buyers, but only hundreds of tons are being ordered as compared with thousands at one time. When improvement does come there may be a stiffening in price. During last week there were shipments of pig iron to Antwerp and home ports, and also of ingot moulds—a growing trade—to Welsh ports.

Iron Ore.

The iron ore trade is quiet, and will remain so until the iron trade improves. None of the mines is very brisk. Foreign ore is in moderate demand, and there are amounts of Spanish ore arriving regularly, but not in very great quantities.

Steel.

The steel trade does not call for much remark at present, and there are not many orders to deal with. The future is uncertain and is largely governed by the unsettled state of labour. When all the railway groups are a reality it is expected that there will be many inquiries for rails in view of renewals all over the country. The hoop works keep busy, but the new department for dealing with special sections, mostly destined for Sheffield, has not started yet. Engineering is very dull, and shipbuilding as bad. The acceptance of a reduction in wages by many of the unions has not sent many men back owing to the action of out-of-works, who strongly picket the gates. The remarkable thing about many of the most active pickets is the fact that they are of the so-called unemployed class, who are "helping the engineers," according to their explanations. A Labour man explained that the unemployed, who were strongly Communist, had taken the matter out of the hands of the union, and were keeping many hundreds away from work.

SHEFFIELD.

(From our own Correspondent.)

"Peaceful Picketing" Paralysis.

UP till the middle of last week Sheffield engineering and steel works had been able to continue on a more or less restricted scale with the orders in hand. But the "mass picketing" methods then introduced have gradually brought nearer the complete stoppage that will inevitably result unless stronger resistance is offered by the authorities to this means of "peaceful persuasion." The locked-out men and strikers assemble in dense crowds at the entrances to the various works, and without resorting to actual violence—though unsparing in their threats—they offer effectual resistance to those men who have been prepared to go back on the employers' invitation, and to the men not directly concerned in the dispute, and to the apprentices and works pupils. Up to the present the police have taken no steps to prevent this obstruction, and the employers have not, on their part, sought to exercise any right of entry to their premises, so that the locked-out men and strikers are completely masters of the situation. In a number of cases where men were still working, the "massed pickets" have forcibly entered the works and compelled the men to come out. The employers and police have not taken any serious measures to prevent even this form of picketing and intimidation. Under these circumstances, it cannot be much longer before there is a complete cessation of activities in this district. The men are strengthened in their resistance by reports which are being assiduously circulated that there are plenty of orders now at the works awaiting execution; they are convinced that if this is so, the employers will soon be forced to moderate their demands. So far as any general application is concerned, these rumours are entirely without foundation, and they are obviously inspired with the deliberate purpose of misleading the men in their estimate of the employers' resistance and staying powers. What truth there is in these reports relates mainly to the lighter trades—agricultural and gardening implements, files and other small tools, for which travellers are sending in some very satisfactory orders. These firms are not parties in the present dispute, but they have, all the same, received the attentions of the picketing squads, some 300 or 400 strong, who have insisted on the men engaged in the shops coming out in sympathy. The paralysis by these methods is thus extending to departments which are in no way concerned in the dispute, and it is not surprising to learn that the employers are getting somewhat restive in the helpless position in which they find themselves as a result of the curiously complacent attitude of the police authorities.

Boilermakers Busy.

An exception to the prevailing depression in the heavier engineering department is to be found in the case

of Davy Brothers, Limited, the well-known engineers and boilermakers. They have just secured from the Bolsover Colliery Company an order for six Lancashire boilers, 30ft. long by 8ft. 6in. diameter, 160 lb. working pressure. This installation is for the Clipstone Colliery, where, as recently announced in this column, a fine seam of coal, 6ft. thick, has been reached at a depth of 640 yards. This pit will be one of the most up to date in the country, and when in full working order will be capable of a daily output of 4000 tons. There are already six boilers of the same size and make working at this colliery, and evidence of the recovery in the colliery industry is to be found in the fact that Messrs. Davy Brothers have recently executed a number of other very satisfactory orders for Lancashire boilers for various collieries. They have completed a number of large oil storage tanks and a considerable length of gas mains for by-product works, and have also in hand an order for eight stills, 28ft. long by 9ft. diameter, complete with steam coils and other fittings, for one of the large oil corporations. Davy Brothers are, in fact, in the fortunate position of having been able to keep working on an average six days a week throughout the bad period experienced by the engineering industry generally. A certain amount of tramway work has also been done in Sheffield recently, some of which, it is said, is to the order of Russia, but some reticence is observed with regard to it. The revival in the Lincolnshire ironstone district, to which reference was made last week, seems to be rapidly developing, with the result that Scunthorpe and Frodingham, whose existence depends entirely on the iron and steel industry, and which felt the effects of the slump perhaps more severely than any other towns, are now distinctly more optimistic concerning the outlook. Along with the famous Frodingham Iron and Steel Works, which has managed to keep some of its departments going, the Redbourn Hill and Normanby Park Works are now getting a share of the new trade. In addition to the two blast-furnaces, three steel furnaces and the rolling mills have been started at Redbourn, and at Lysaght's Normanby Park Works, where gas was put into two steel furnaces a week ago, rolling has since been resumed.

Tariff Troubles.

To aggravate the difficulties of the situation, steel makers are very much concerned at the menace offered by the tariff proposals of a number of countries which in the past have been among Sheffield's best customers. Mr. Arthur Balfour, who last autumn persuaded the American Tariffs Committee to defer the operation of the Fordney tariff, which would practically have shut out Sheffield special steels, is once more arguing Sheffield's case in the States. The revised duties now before the American Senate are rather less drastic than the original proposals, but they are still high enough to be prohibitive. I understand that Mr. Balfour is hopeful of securing a further postponement of the matter. Sheffield Chamber of Commerce has also received information that there is a movement in Paris for very largely increasing the French steel tariff. Representations are being made on behalf of Sheffield manufacturers, who in that case again would be badly handicapped. It may be recalled that a few months ago a very high Spanish tariff was introduced, to the detriment, among other trades, of Sheffield steel makers. The Sheffield Chamber also finds it necessary to send a special deputation to Italy to make representations concerning that country's tariff. Mr. William Clark (President of the Chamber and managing director of Vickers Limited, at Sheffield), Mr. Peter MacGregor (managing director of Sanderson Brothers and Newbould, Limited), and Mr. J. C. Ward (director of Edgar Allen and Co., Limited) have been appointed to interview the Italian authorities, but they have deferred their visit till the Genoa Conference has concluded. The agricultural implement and the electrical trades have asked to be associated with this deputation, but the Sheffield Chamber feel that Sheffield steel trade is in so unique a position that the deputation should be concerned exclusively with it.

Cheaper Fuels.

The coal position is a trifle easier, though the demand for industrial fuels will not, of course, improve until a settlement is reached in the engineering dispute. Prices are tending in the consumer's favour, however, colliery companies being assisted in this effort by the recent wages ascertainment. When industrial conditions permit a resumption of work on a satisfactory scale, manufacturers will also be materially helped by the reduction in the price of gas to 7d. per therm, this as compared with the 9d. originally fixed by the company representing a saving to the consumers of something like £200,000 per annum. A course of lectures of much value to industrial fuel consumers has been arranged by the Fuel Technology Department of Sheffield University. Mr. F. S. Sinnann, Lecturer in Fuels at the College of Technology, Manchester University, and Director of Research for the Lancashire and Cheshire Coal Research Association, lecturing on "The Preparation of Coal for the Market," said that Sheffield seemed to have more purifying plants than any other coal centre in England. Dealing with present-day industrial requirements, he said the time had come when colliery proprietors must see that coal was sent out of such uniform size and ash content that the consumer could run his furnaces on set working conditions. Research could now be most profitably directed to the discovery of a means of utilising the large amount of fine coal which most collieries found it difficult to dispose of.

Reservoir Construction.

Sheffield City Council has accepted a compromise between two experts whose opinions were sought with regard to the rebuilding of the Damflask reservoir wall, which recently collapsed. There were differences of opinion between the two experts as to the number of supports necessary and the extent of the underpinning. The Corporation is also constructing a new service reservoir at an estimated cost of £60,000.

Wireless for Farmers.

Efforts are to be made by the Sheffield Wireless Society—one of the strongest of such societies in the country—to secure for Sheffield a more prominent place in connection with the proposed broadcasting scheme than appears to have been allocated to the district. The farmers of Yorkshire are also interesting themselves in the scheme, which it is thought might be made very serviceable in connection with the distribution of market and weather reports. The matter has been discussed by the Malton Chamber of Trade, and representations are to be made on the desirability of establishing a broadcastng station in that district.

NORTH OF ENGLAND.

(From our own Correspondent.)

A Brighter Outlook.

ALTHOUGH there is no marked expansion in trade in the North of England, the outlook is regarded as more cheerful and encouraging, and it is generally felt that, with a complete settlement of the labour troubles, a revival on a large scale would soon be experienced. The termination of the shipyard workers' strike is welcome news, though at the moment little hope can be held out that the position so far as employment is concerned will be materially affected. Very few of the yards on the North-East Coast have work on hand, and consequently when operations were resumed on Monday only a very small proportion of the workers were found employment. The end of the dispute, however, has prevented the loss of some valuable contracts for repair work. Had not a settlement been reached two important repair contracts secured by the Smith's Dock Company, Middlesbrough, would have gone to the Continent. As it is, the Tees-side firm will now be able to undertake the work, and the workers will reap the benefit. Another encouraging feature in connection with the shipbuilding trade is a revival in the number of inquiries. Some of the estimating departments of the shipbuilding establishments are stated to be busily occupied in the preparation and submission of prices. At a time when the home trade in iron and steel is very depressed it is particularly encouraging to learn that inquiries are now being received in Cleveland from the United States for pig iron. Large shipments of ferro-manganese have been arranged, and substantial sales of other qualities of pig iron have also been fixed up. It is a mistake, however, to surmise that this business is in any way the outcome of the United States coal strike. As a matter of fact, the coal strike has in no way retarded the production of pig iron across the Atlantic, and there is no prospect of the Cleveland makers being able to pay freight charges and compete in the American market for ordinary qualities of pig iron. But in special kinds of iron, and especially ferro-manganese and spiegel, Cleveland has always done a good trade with America, and these new orders come at a very appropriate time to tide over a dull period in the home trade.

Cleveland Iron Market.

A more cheerful tone prevails on the Cleveland iron market, although the total volume of business is still kept within narrow limits, and must necessarily remain so as long as the home trade continues to be crippled by the engineering stoppage. The foreign inquiry, however, is active once more, and a few good sales have been effected. In addition to America, Germany is still buying on a large scale, and the Scandinavian market has improved. All this compensates for the loss of the home trade and enables makers to carry on without accumulating stocks. Some consumers entertain the belief that pig iron prices are likely to fall ere long, and for this reason are holding off the market. There does not, however, appear to be any likelihood of such a contingency. Indeed, prices are more likely to advance than fall. It is known that many of the works have very little iron in stock, and the probability is that with a settlement of the engineers' dispute everybody would be clamouring for supplies. There are only five blast-furnaces producing Cleveland pig iron, makers have very little stocks, and there is every possibility of a "squeeze." Moreover, ironmasters declare that they would rather blow their furnaces out than cut prices any further. Even now some are selling at a loss owing to the high costs of production.

Hematite Pig Iron.

The demand for East Coast hematite pig iron on home account is very quiet, but Germany continues to take fairly large supplies. Makers are selling for export at 95s., but will sell mixed numbers to home consumers at less than 96s., and No. 1 at 97s.

Iron-making Materials.

There are extremely few inquiries for foreign ore, but deliveries are on a very heavy scale this month. Sellers continue to quote 27s. per ton for best Rubio ore, but that figure might be shaded. No further fall in fuel prices has occurred, but ironmasters can now get good Durham furnace coke delivered at the works for 28s.

Manufactured Iron and Steel.

Although business in manufactured iron and steel shows little or no improvement, manufacturers are inclined to take a more confident view of the outlook. The general belief is that if the engineers were only back at work a moderate volume of orders would be placed. Makers adhere firmly to the fixed home prices, but are cutting to the extent of 30s. per ton in some cases for export business

The Coal Trade.

The position of the northern coal trade shows little change of importance on the week, though the outlook is regarded as more cheerful and encouraging. The inquiry from abroad is keeping well up to the recent standard, but for the most part the actual business being transacted is only of modest proportions, with the exception of the German trade, which has considerably expanded, and is still being augmented as a result of the remission of the import duty. The call from that quarter is chiefly for second-grade sorts and smalls, which are being cleared at the quoted rates. The Berlin gasworks have purchased through foreign merchants about 200,000 tons of second Durham gas coals for delivery during the next four months at round about 21s. 6d. per ton f.o.b. It is also understood that Hamburg merchants are endeavouring to cover some of their commitments for this class of coal at about 25s. 9d. per ton c.i.f. for early delivery; but this price is considered to be insufficient compared with current quotations. There is some disappointment as to the effects of the American strike. It was expected that there would be a heavy inquiry from South America and other Transatlantic countries, while the Italian and other Mediterranean shipments have not expanded to the extent anticipated, although there is a little more expected from Italy now that the stocks of American coals are being rapidly exhausted. The Northumberland steam coal trade is fairly satisfactory at present. Most of the Blyth collieries are well stemmed and bests are firm, but Tyne primes can often be discounted. What is needed is a heavier forward booking, so that the values may become stabilised. Smalls are fairly steady, but unscreened are easy. Gas coals are firm in the case of special sorts and the prime brands, but second grade is not uniform, and some of the fitters have surplus supplies available, both for prompt and forward. Coking is only patchy, with prices unchanged, but in odd cases they can be discounted. The bunker market is fairly steady, and prices cannot be discounted to any extent for any class, while for the best brands the market is firm. The coke market is quiet throughout, and though none of the prices is quotably altered the position is easier for all classes.

SCOTLAND.

(From our own Correspondent.)

Fair Start on the Clyde.

WORK is far from plentiful at the Clyde shipyards, and only a certain number of men can be employed. Of that number a good percentage presented themselves on Monday last. The continuance of the engineers' lock-out is, of course, detrimental to work at the yards, and it is hoped that an early settlement of this dispute will be followed by a decided improvement in trade. Rumours of fresh work are current, but nothing definite is likely to be heard of them until peaceful labour conditions prevail.

Discovery of Oil.

For a long time now Messrs. Pearson and Co. have been carrying out boring operations at D'Arcy and West Calder. The Government is interested in both enterprises. Twelve months ago the work at West Calder was suspended, but operations continued at D'Arcy. Tremendous difficulties have been met with, which demanded a large measure of patience on the part of the workers, but it is believed that the effort has now been rewarded. What has been described as a satisfactory yield of liquid oil has been found at a depth of between 1800ft. and 1900ft. Operations were suspended on Monday night last, and officials and experts of the company are to investigate the find at the earliest possible moment. The discovery has been made on a hill south of Dalkeith situated on property owned by the Marquis of Lothian.

Outlook Improving.

The demand for materials of all descriptions continues quiet, but there is a more hopeful feeling abroad. Consumers at home and abroad are showing more interest in the markets generally, and were more reason for confidence in the labour situation apparent, a change for the better would soon follow. Prices generally are much nearer a reasonable level, and manufacturers are willing to meet consumers, but the uncertainty of the labour attitude is entirely detrimental to the establishment of a feeling of security. There is little doubt that the bigger proportion of the rank and file is sick of unemployment caused by a succession of labour disputes, and would gladly settle down on something approaching a pre-war standard with the cost of living on a relative scale.

Pig Iron.

Buyers of pig iron are said to be taking a little more interest in the market, but the turnover shows little expansion so far. Inquiries are more numerous, but they would appear to be more as a test of the market than a forerunner of actual business. At any rate, the small number of furnaces in blast is still more than equal to the demand. The usual weekly meeting of the Glasgow pig iron ring passed without any transactions being recorded, but sellers were quoted as follows:—Makers' iron: Scotch No. 3, 97s. 6d. cash f.a.s. Glasgow; Middlesbrough No. 3, 97s. 6d. cash f.o.b. Middlesbrough; and mixed numbers East Coast hematite, 97s. 6d. cash f.o.b. Middlesbrough.

Steel and Iron.

The steel works have very little of fresh interest to record. At the majority of the establishments mills are running slowly, but inquiries have taken a turn during the past few days, especially from overseas. Black and galvanised flat and corrugated sheets have more inquiries for best grades, while Far Eastern markets show interest in the cheaper qualities. Tube makers are not doing much. Bar iron continues dull. The reductions in prices have not attracted buyers to any extent, though there is perhaps a shade more going through for export.

Coal.

While the outlook may be said to be a shade brighter, actual business is still on the slow side. The re-start at the shipyards may help the industrial demand, but other departments are equally in need of orders. In almost all districts employment is decreasing consequent on the slackness in foreign export, which is particularly disappointing at present. Prices can be arranged both for home and export delivery, but buyers everywhere are pur-

chasing very cautiously, and in most instances almost solely for immediate requirements. Practically all descriptions of fuel are plentiful, and though approximate values show practically no change, cheap lots can be negotiated for almost any sorts. Household fuel is very difficult to sell at present, and prices are irregular, varying between 1s. 9d. to 2s. 1d. per cwt. for good qualities. Aggregate shipments for the past week amounted to 212,402 tons against 214,173 tons in the preceding week, and 352,255 tons in the same week in 1913.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THE feature of the steam and anthracite coal market is the firmness maintained, both for prompt shipment and also for forward delivery. At one time it looked as if there might be some weakness developing, but this appears to have disappeared, at any rate for the present, and coalowners are declining to entertain anything less than current prices. The stoppage of a day's work in the coalfield last week enabled shipping operations to catch up with standing supplies, so that there is no easiness, that is as yet apparent, on account of any shipper being unable to effect the prompt clearance of wagons. Colliery companies are pretty well stemmed, and do not seem to be perturbed regarding the future. They are said to have done good business recently for foreign depôts, and in the case of Monmouthshire coals, it is understood that owners have received more inquiry during the past week than they have had for several weeks. At the same time, exporters find it difficult to carry through fresh operations with buyers abroad, as their stocks are still fairly substantial, and those who hold them are selling them at a lower figure than coals can be shipped from this district. For the time being therefore business will be difficult, especially so far as Italy is concerned, notwithstanding that rates of freight are so low, comparatively speaking. The position of shipowners is without doubt a very trying one, as rates are so depressed as to be practically on a pre-war level in some directions, notably for France, and it is hard to see how the running of ships can be remunerative. This being the case, the probability is that many owners will have temporarily to lay up their tonnage, which, of course, means that an exporter with future c.i.f. business in contemplation must reckon on higher rates of freight than those now ruling, unless he is to run an abnormal risk, although at the same time this entails the chance that buyers abroad may consider his price too high, and he may be cut out by competitors. Among the new inquiries in the market for coals is one for 15,000 tons of steam coals for the Palestine Railways, for delivery at Haiffa from June to the end of September, while the French Railways require prices for about a similar quantity of large and small coals, subject to analysis.

Miners' Allegations.

The South Wales Miners' Federation has held its special delegate conference, when the President—Mr. Vernon Hartshorn—gave his view regarding the position in the coalfield, and said that owners were taking advantage of the situation to impose unfair conditions upon the men at work and the victimisation of lodge officials, committeemen and other active members of the Federation by refusing to re-employ them after the stoppage of last year. As regards the question of wages, although as a result of the national agreement the wages were far below the cost of living, the employers had used their strong position to enforce other reductions upon thousands of workmen. Before, however, the employers could be effectively dealt with, he urged that the whole of the men employed at the collieries must resume membership of the Federation. The result of the conference was that a resolution was passed that unless the report of the officials to the annual conference in June is satisfactory regarding the non-unionist question, then the lodges are to be asked to authorise their delegates to decide that fourteen days' notice be tendered to enforce membership of the Federation. The conference also condemned the action of various colliery owners in their victimisation of workmen as a punishment for their activities in connection with the Federation, and protested against the non-observance by coalowners of the terms of the national agreement, the disregarding of former practices, customs and price lists, and the enforcement of unjustifiable reductions in wages. It was decided that if these grievances shall not have been remedied by the date of the annual conference, the notices on the non-unionist question "shall also be used to this purpose." It is interesting to note that the Communists in this district are now coming more out into the open. Delegates of the twenty-five branches of the Communist Party in South Wales have also had a conference at Cardiff, and they claimed to represent 25,000 Communists in this district. The conference passed a number of resolutions opposing overtime and the move on foot by the owners to lengthen the working day. Lodges were urged to press for a six-hour day and a five-day week. Other resolutions made it apparent that the members mean to take a very active part in all matters affecting the Miners' Federation, and in view of the widespread dissatisfaction with the present wages agreement, the conference urged all Communist Party Industrial Nuclei to see to it that the necessary three months' notice is given, so as to ensure the agreement terminating on December 31st next.

Docks Combine.

It looks very much as if before very long the Swansea Docks will join the Western Group under the control of the Great Western Railway, and it is not likely that bondholders of the Swansea Harbour Trust will be at all sorry. It is understood that definite terms for the exchange of stock have been offered, and that they involve an exchange of Great Western guaranteed 5 per cent. for Swansea Harbour Trust 4 per cent., in the proportions of £80 for £100, and that the Great Western Company is prepared to pay off the accrued interest on the harbour stock, which will shortly be three years in arrear.

Tinplaters' Wages.

The Joint Industrial Council of the Welsh Tinplate and Sheet Trade considered at the end of last week the application of the tin-plate workers for an increase in, or the retention of, the 7½ per cent. bonus on the basic rates of wages. The men asked for 10 per cent., but the employers offered 5 per cent. It was ultimately agreed to continue the existing 7½ per cent. for a further three months.

Current Business.

The tone of the steam coal market is well maintained, and it is difficult to get supplies for prompt loading. Colliery salesmen are firmly adhering to 28s. 6d. to 29s. for the best Admiralty large and 28s. 6d. for second qualities, while for the superior descriptions of Monmouthshire large owners are quoting 27s. to 27s. 6d. Best steam smalls remain at 19s. to 20s., while patent fuel manufacturers are in most cases very full up for this month, and prices range from 25s. to 28s. 6d. Anthracite coals are better, and are scarce for most descriptions. Owners will only sell for fairly prompt shipment, and decline to make offers for shipment ahead, as with the continuance of the strike of the American miners they appear confident that they will be able to command even higher prices than those now current.

Cardiff Dowlais Works.

The announcement is made that the work of "digging out" a furnace has been started at the Cardiff Dowlais Works, this being the preliminary to actual operations. When completed this will mean full-time employment for 200 men or part time for 400 men. A contract has been entered into for the production at Dowlais of 5000 tons of rails for a South of England railway company.

HARBOUR IMPROVEMENTS IN CUBA.

IN view of the promised revival in Cuba's import and export trade, steps are being taken by the Government to effect certain long-desired harbour improvements, particularly at Matanzas, a province bounded on the north by the Straits of Florida, on the east by the province of Santa Clara, and on the west by the province of Havana, with the capital 54 miles distant. The harbour, which is served by the United Railways of the Havana, a British-owned system, is situated at the head of an arm of the sea, about five miles in length and a mile or so in width, and receives the waters of the San Juan and Yumuri rivers. At the end of the harbour, nearest to the city of Matanzas, the Government owns and operates a wharf known as Muelle Reál, which has a length of 116ft. and is covered with warehouses of wooden frames and zinc roofs; the draught alongside is 12ft. to 13ft. The position of the wharf between the mouths of the San Juan and Yumuri rivers, where mud accumulates rapidly and continuously, makes dredging impracticable; as a result, all merchandise must be discharged either by means of barges or lighters. To improve this uneconomical state of affairs the Government has decided to construct a long concrete pier with sufficient draught to permit coastwise shipping to come alongside, and, at the same time, to reconstruct the warehouses in concrete. Other improvements include the construction of docks at Mariel, about 20 miles from Havana, the concession having been granted to a large steamship company, whose example is being followed by other firms with a view to preventing a recurrence of dock congestion in Havana.

HYDRO-ELECTRIC SCHEMES IN NEW ZEALAND

IN a recent statement the New Zealand Minister of Public Works explained the position of the development of hydro-electric power in the Dominion. With regard to the three main sources of supply in the North Island, the Minister stated that at Mangahao they were proceeding at once with the development of 24,000 horse-power, which he anticipated would be ready by the end of 1923. At Waikaromoana a plant of 1000 horse-power was in course of construction, but he was of the opinion that until the general financial position of the Dominion became clearer the main development at that station would be held over.

The Minister stated also that he did not consider that the Arapuni scheme should be proceeded with until sufficient financial provision was assured to enable the work to be completed in the shortest reasonable time, and that that time should be limited to five years in order to limit the payment of interest on the capital involved. He also pointed out that materials and costs show a downward tendency, and that it was unlikely that the rate of interest on borrowed money would remain at its present high level for a long period of years. He was of the opinion also that in view of the importance of the scheme all smaller schemes in the Auckland district should be put on one side. With regard to the Public Works Department's expenditure on hydro-electricity, it was stated that it was now, and would be for the next three years, approximately four times the rate of expenditure in any previous year, and a list of commitments was given totalling upwards of £3,500,000 for developments to the end of the year 1923–24.

WATERWAY FROM MARSEILLES TO THE RHONE.

IT is reported from Paris that M. Millerand is about to inspect the first part of the work in connection with the execution of the scheme for extending the port of Marseilles and linking up its docks with the Rhone at Arles. The present port of Marseilles is inadequate for the quantity of shipping using it, and it was accordingly suggested some time ago that the docks might be joined by canal with the Berre Lake, a large sheet of water some 16 miles north-west of Marseilles, which is of irregular shape, and varies from 6 to 9 miles across. In this lake it was proposed to construct docks to accommodate shipping unable to enter the regular port of Marseilles. As the scheme was elaborated, a plan for linking up the Berre Lake with another sheet of water known as the Caronte, and thence by way of a canal, with the Rhone at Arles, was put forward and is being executed. It is the first part of the work that will be inspected by M. Millerand.

The canal to the Rhone, after leaving Marseilles, follows the coast actually in the sea, from which, however, it is protected by a sea wall as far as the port of La Lave, at Estaque, after which it pierces the mountainous chain of the Rove, a tunnel more than 4 miles long and 66ft. wide; it then passes through a cutting, reaches the Berre Lake, follows its southern shore as far as Martigues, thence it coincides with the old canal from Martigues to Port-le-Bouc, which, however, is enlarged and joins the already existing canal from Port-le-Bouc to Arles, which, also much enlarged and improved, finally joins the Rhone.

This ambitious scheme, which will link up Marseilles by water with the interior of France, and provide new docks in the Berre Lake, is practically completed; the Rove tunnel is finished, and the new port of Caronte is being constructed. In two years' time barges will be able to go direct from Marseilles to Arles, and thence up the Rhone. This, however, is not all; it is proposed to make the Caronte and Berre Lakes accessible to large sea-going vessels. For this it will be necessary to make the waterway from Port-le-Bouc to Martigues deeper, the entrance to the Berre docks being *vid* Port-le-Bouc in order to avoid the Rove tunnel. It is estimated that this part of the work will take from five to six years, but when it is completed, Marseilles, with its inland docks, will be one of the largest ports in the world.

Catalogues.

HIGGS BROTHERS, Sand Pits, Birmingham.—A copy of this firm's cheerful little monthly magazine has been received. Although a great deal of space is devoted to "lighter vein," there is much useful information given therein.

GEORGE WALLER AND SON, Limited, of Phœnix Ironworks, Stroud, Gloucester, have just issued a new catalogue in connection with exhausting machinery and its accessories. Different plants are described and illustrations have been embodied of the many machines which the firm manufactures.

VICKERS Limited, Vickers House, S.W. 1.—A new leaflet with a brief description of Vickers' rust-proof golf club heads. They are manufactured at the River Don Works, Sheffield. A complete range of iron heads, comprising niblick, mashie niblick, mashie, mid-iron, cleek and putter is available.

THE STANTON IRONWORKS COMPANY, Limited, near Nottingham.—A copy of cast iron pipe stock list for April. These pipes in stock are ready for immediate delivery. A copy of the list of principal users of the Stanton Hume reinforced concrete pipe. These pipes are available from 4in. to 60in. diameter.

UNIVERSAL DIE CASTING AND METAL COMPANY, Limited, 7–9, Farm-lane, Walham Green, S.W. 6.—A copy of leaflet on white metal bearing alloys or anti-friction (Babbitt) metals. "Udcam" products include pressure die-cast bearings, pressure-lined gun-metal shells, pressure-lined connecting-rods, general die castings, anti-friction metals and white metal alloys.

J. S. WATSON (GAINSBOROUGH), Limited, Gainsborough.—Illustrated catalogue of steel vessels of all types up to 250ft. in length. The firm has now constructed over 1000 craft for all parts of the world for rivers and ports work. Many of these vessels are built in sections and are put together on reaching their final destination. Views are given of many different types.

SPENCER BONECOURT, Limited, Parliament Mansions, Victoria-street, S.W. 1.—The reprinted copy of a paper on "Modern Steam Generators for the Efficient Utilisation of Gaseous Fuels and the Efficient Recovery of Waste Heat," by Mr. P. St. G. Kirke, read before the West of Scotland Iron and Steel Institute. We understand that copies of this paper may be obtained from the firm.

THE ENGLISH ELECTRIC COMPANY, Limited, Queen's House, Kingsway, W.C. 2.—A copy of publication No. 304, entitled "The English Electric Industrial Motor." A good description of this motor and its parts is given, together with photographs and diagrams. The motor is made in two main classes, viz., C.B. motors for direct and alternating current, squirrel cage type, and A.C.S. motors, slip ring type, for two or three-phase current. Publication 319 contains a description, fully illustrated, of the electrically driven reversing rolling mill at the Skinningrove Ironworks of the Skinningrove Iron Company.

HENRY BERRY AND CO., Limited, Croydon Works, Leeds.—A copy of this firm's "Rubber Machinery for Plantation Use" catalogue has been received. A rubber scrap-washing machine is described and illustrated with picture and detailed drawings. It is produced on entirely new lines, and is of massive construction, weighing over three tons. Plantation washers are described and illustrated, also mangles and rollers. An illustration is included of one of Berry's 4000-ton hydraulic rubber sheet vulcanising presses with loading table. Berry excavators are embodied in another pamphlet. Besides a description of the machines, views are given of them working on different contracts.

THE CONSOLIDATED PNEUMATIC TOOL COMPANY, Limited, Egyptian House, 170, Piccadilly, W. 1.—The following circulars have been received:—No. 74: Illustrating the C.P. rock drill, which is made in two sizes. Class P 2 D,G.L. petrol-driven portable air compressor ready for the road and ready for work is illustrated. No. 75: The Little Giant B.Q.-46 hammer drill is described and illustrated. This type is suitable for road repair work or demolishing old buildings. No. 76: The C.P. electric welding plants (resistance system) are described and illustrated. Plants operating are shown. No. 77: This circular describes Class N single enclosed self-oiling steam and belt-driven air compressors. Cross sections of belt-driven and steam-driven air compressors are included.

FISHER, HUMPHRIES AND CO., Limited, Atlas Works, Pershore.—Catalogue descriptive of machinery for the cold rolling and tube trades. It is now in its third edition, and whilst it is not a complete list, it gives some indication of the range of the firm's manufactures. The Fisher billet piercing machines are described, also Pilger mills. These two machines when used in conjunction enable the two operations of piercing and pilgering to be performed in the same heat. Standard fly-wheels and driving gear are illustrated, besides vertical forging and reducing machines, tagging and pointing machines, horizontal coning machines, and reeling and straightening machines, and many others. The Fisher tube testing benches for all classes of tube-proving work are also described and illustrated.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	23/-
(1) Spanish	28/-
(1) N. African	28/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	27/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) **SCOTLAND—**		
Hematite	5 5 0	—
No. 1 Foundry	4 17 6	—
No. 3 ,,	4 12 6	—
N.E. COAST—		
Hematite Mixed Nos.	4 16 0	4 15 0
No. 1	4 17 0	4 16 0
Cleveland—		
No. 1	4 15 0	4 15 0
Silicious Iron	4 15 0	4 15 0
No. 3 G.M.B.	4 10 0	4 10 0
No. 4 Foundry	4 7 6	4 7 6
No. 4 Forge	4 5 0	4 5 0
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
MIDLANDS.		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
Part Mine Forge	*None offering.*	
North Staffs. No. 3 F'dry	4 5 0 to 4 10 0	
(3) Northampton—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	4 0 0	—
,, Forge	3 10 0 to 3 12 6	
(3) Derbyshire—		
No. 3 Foundry	4 2 6 to 4 5 0	
Forge	3 12 6 to 3 15 0	
(3) Lincolnshire—		
Basic	4 0 0 to 4 5 0	
Foundry	4 5 0 to 4 10 0	
Forge	4 2 6 to 4 5 0	
(4) **N.W. COAST—**		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 15 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 0 0	10 15 0
Best ,,	12 0 0	—
N.E. COAST—		
Crown Bars	12 0 0	—
Tees	14 10 0	—
LANCS.—		
Crown Bars	11 10 0	—
Hoops	14 0 0	13 15 0
S. YORKS.—		
Crown Bars	12 0 0	—
Best ,,	13 0 0	—
Hoops	14 0 0	—
MIDLANDS—		
Marked Bars (Staffs.)	13 10 0	—
Crown Bars	11 10 0	—
Nut and Bolt Bars	10 5 0	—
Gas Tube Strip	11 10 0 to 11 15 0	
Hoops (*Nom.*)	14 0 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) **SCOTLAND—**		
Boiler Plates	14 0 0	—
Ship Plates ⅜in. and up	10 10 0	—
Sections	10 0 0	—
Steel Sheets ⅛in. to ⅜in.	11 15 0	—
Sheets (Gal. Cor. 24 B.G.)	—	16 10 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 10 0	—
Angles	10 0 0	—
Boiler Plates	14 10 0	—
Joists	10 10 0	—
Heavy Rails	9 10 0	—
Fish-plates	14 10 0	—
Channels	14 10 0	—
Hard Billets	9 5 0	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 10 0	—
Light ,,	11 0 0 to 13 0 0	
Billets	9 5 0	—
Ship Plates	10 10 0	—
Boiler ,,	14 10 0	—
MANCHESTER—		
Bars (Round)	10 0 0 to 12 0 0	
,, (others)	11 0 0 to 12 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	£10 to 12	10 0 0
,, (Lancs. Boiler)	16 0 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0 to 11 0 0	
Bessemer Billets	12 10 0	—
Hard Basic ,,	9 5 0	—
Soft ,,	7 15 0	—
Hoops	12 5 0	—
Soft Wire Rods	11 0 0	—
MIDLANDS—		
Small Rolled Bars	9 5 0 to 9 10 0	
Bessemer Billets	7 12 6	—
Hoops	11 15 0 to 12 0 0	
Gas Tube Strip	10 5 0 to 10 10 0	
Sheets (24 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets (f.o.b. L'pool)	16 0 0 to 16 10 0	
Angles	10 0 0	—
Joists	10 10 0	—
Tees	11 0 0	—
Bridge and Tank Plates	10 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/6 to 19 9
Block Tin (cash)	148 15 0
,, (three months)	150 5 0
Copper (cash)	69 5 0
,, (three months)	69 12 6
Spanish Lead (cash)	24 10 0
,, (three months)	23 2 6
Spelter (cash)	27 5 0
,, (three months)	28 2 6
MANCHESTER—	
Copper, Best Selected Ingots	65 0 0
,, Electrolytic	67 0 0
,, Strong Sheets	88 0 0
,, Loco Tubes	0 1 1½
Brass Loco Tubes	0 0 11½
,, Condenser	0 1 2½
Lead, English	25 10 0
,, Foreign	24 10 0

FERRO ALLOYS,

(*All prices now nominal*).

	Per Ton.	Per Unit
Tungsten Metal Powder	1/6 per lb.	
Ferro Tungsten	1 4 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£27	10/-
,, 6 p.c. to 8 p.c. ,,	£26 10 0	9/-
,, 8 p.c. to 10 p.c. ,,	£25 10 0	8/-
,, Specially Refined		
Max. 2 p.c. carbon	£70	20/-
,, 1 p.c. ,,	£88	31/-
,, 0·75 p.c. carbon	£103	37/-
,, carbon free	2/- per lb.	
Metallic Chromium	5/3 per lb.	
Ferro Manganese	(per ton) £15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£25 10 0 scale 6/- per unit	
,, Vanadium	20/- per lb.	
,, Molybdenum	7/- per lb.	
,, Titanium (carbon free)	1/3 per lb.	
Nickel (per ton)	£180	
Cobalt	14 - per lb.	
Aluminium (per ton)	£110 to £120 (British Official).	

FUELS.

	SCOTLAND.	Export.
LANARKSHIRE—		
(f.o.b. Glasgow)—Steam		20 6
,, ,, Ell		21/-
,, ,, Splint		21 6 to 23 6
,, ,, Trebles		19 6
,, ,, Doubles		18/-
,, ,, Singles		17/-
AYRSHIRE—		
(f.o.b. Ports)—Steam		20/-
,, ,, Splint		21 6
,, ,, Trebles		19 6
FIFESHIRE—		
(f.o.b. Methil or Burntisland)—Steam		18/- to 22/-
Screened Navigation		26/6
Trebles		20/-
Doubles		18/-
Singles		17/9
LOTHIANS—		
(f.o.b. Leith)—Best Steam		20/-
Secondary Steam		19 6
Trebles		19 9
Doubles		18 6
Singles		17 6
	ENGLAND.	
(8) **N.W. COAST—**		
Steams		33/-
Household		40/- to 51/-
Coke		34/-
NORTHUMBERLAND—		
Best Steams		22 6 to 23/-
Second Steams		21/6 to 22/-
Steam Smalls		13/- to 15/-
Unscreened		20/6
Household		25/- to 30/-
DURHAM—		
Best Gas		23/-
Second		21/- to 22/-
Household		25/- to 30/-
Foundry Coke		32 6 to 35/-
SHEFFIELD—	INLAND.	
S. Yorks. Best Steam Hards	22/- to 23/-	—
Derbyshire Hards	21/- to 22/-	—
Seconds	20/- to 21/-	—
Cobbles	20/- to 21/-	—
Nuts	18/- to 19/-	—
Washed Smalls	11/- to 12/-	—
Best Hard Slacks	12/- to 13/-	—
Seconds ,,	10/- to 11/-	—
Soft Nutty ,,	7/6 to 8 6	—
Pea ,,	7/- to 8/-	—
Small ,,	2/- to 4 6	—
House, Branch	37/- to 39/-	—
,, Best Silkstone	33 - to 35/-	—
Blast Furnace Coke (Inland and Export)	19/- to 21/-	
CARDIFF—	(9) SOUTH WALES.	
Steam Coals:		
Best Smokeless Large		28/6 to 29/-
Second ,, ,,		28/- to 28/6
Best Dry Large		26/6 to 27 6
Ordinary Dry Large		25/- to 25 6
Best Black Vein Large		27/6 to 28/-
Western Valley ,,		27/- to 27/6
Best Eastern Valley Large		27/- to 27/6
Ordinary ,, ,,		24/6 to 25 6
Best Steam Smalls		19,6 to 20/-
Ordinary ,,		15/- to 19/-
Washed Nuts		25/- to 27/6
No. 3 Rhondda Large		30/- to 32 6
,, ,, Smalls		19/6 to 20/-
No. 2 ,, Large		23/- to 24/-
,, ,, Through		19/- to 20/-
,, ,, Smalls		15/- to 16 -
Coke (export)		34/- to 35 -
Patent Fuel		25 6 to 28 6
Pitwood (ex ship)		31 6 to 32 6
SWANSEA—		
Anthracite Coals:		
Best Large		42 6 to 45/-
Seconds		40 - to 42 6
Red Vein		30/- to 32 6
Big Vein		40/- to 45 -
Machine-made Cobbles		47.6 to 50/-
Nuts		47 6 to 50/-
Beans		45 - to 50/-
Peas		24/- to 26/-
Breaker Duff		10/- to 10 6
Rubbly Culm		16 6 to 17/-
Steam Coals:		
Large		22/6 to 24/6
Seconds		20 - to 22 6
Smalls		14 - to 16/-
Cargo Through		18,- to 20 -

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Trade Obstacles.

It has been a regular experience for many months past that while business always seems on the point of looking up there is invariably something to prevent the slight recovery from developing into a pronounced activity. This week the situation has been dominated by the problem of the European reconstitution, in which this country has unfortunately not the same interests as the other allies. In the opinion of the French, the work of reconstitution should begin at home; that is to say, Germany should be compelled to refund what the French Government has already advanced on account of the reconstruction of the devastated regions, and should fulfil her obligation to make good all the damage she has done, and when France has received her due she will readily co-operate in any work of reconstitution outside her own boundaries. So long as France receives no positive guarantee that the German obligations will be fulfilled, the difficulties in the way of a European reconstitution appear very great, and so far as Russia is concerned, France will stand aloof until her pre-war interests in that country are recognised and until there is some reasonable assurance that it will be possible to carry on business under the Soviet administration. The deadlock has had the effect of creating a pronounced feeling of depression amongst manufacturers, and the outlook is rendered still more unsatisfactory by the Budget estimates showing a deficit of no less than four milliard francs. Consequently, the State is obliged to carry out further rigid economies, which will have the effect of retarding many public works that were expected to provide employment for the engineering industries. There is still a fair volume of orders, but they are wholly insufficient, and makers are obliged to look more and more to foreign markets, which is one of the reasons why so much pressure is being brought to bear upon the Government to modify its fiscal policy. It is noteworthy that some firms, finding themselves unable to dispose of their production on the home market, are taking foreign contracts at very low prices, and one of the leading makers of cast iron pipes has been sending large consignments to South America, China, Roumania, and even to Egypt and India.

Shipbuilding.

The shipyards and arsenals are so far removed from the centres of raw material supplies that they are admittedly unable to compete for foreign contracts, although their situation is so precarious that every possible means have been suggested of enabling them to secure foreign business, without which it is feared that the shipbuilding industry will languish indefinitely. Something has already been done to help shipbuilders by reducing the railway rates on raw material, but the cost of construction is still too high to permit of builders competing with British shipyards. It is now alleged that, in hastening through the first part of its naval programme, the object of the Government was to prevent the closing down of some of the arsenals which are regarded as no longer serving any useful purpose. Instead of giving all the work to private shipyards that are badly in need of employment and can construct much more cheaply than the arsenals, these latter are to build a certain number of vessels that will require the presence of a costly naval staff. Cherbourg is to build four submarines, Brest two light cruisers and one submarine, Lorient one light cruiser and two destroyers, and Toulon one submarine. Private shipyards will build four destroyers, twelve torpedo boats and six submarines.

Import Duties.

In presenting their case for higher import duties on metallurgical products to the Commission for the Revision of Customs Coefficients the iron and steel firms brought forward as their leading argument the necessity of being protected from the steadily increasing importation of material. The real reason, however, why they object to the introduction of foreign iron and steel is that it upsets the calculations of French iron and steel makers who had hoped to dispose of their large surplus production abroad at low figures by maintaining prices on the home market. When the iron and steel firms met the Commission they found themselves against the solid opposition of engineering interests and other consumers who are irritated at what they consider to be an unjustified advance in the prices of material, and who object to pay more for their iron and steel in order that foreign consumers may have cheaper supplies. The Minister for the Liberated Regions also refused to countenance anything which would advance the price of iron and steel required for reconstruction work, and the Minister for Foreign Affairs rejected the proposed increased coefficients because they would create serious complications with Belgium and other countries which already find the existing tariffs far too heavy. The only consolation that could be given to the iron and steel firms was that the coefficients might be slightly increased in special cases, and that they might expect some relief in a further diminution of railway rates.

Paris Traffic.

The works being carried out in connection with the Gare St. Lazare provide for the demolition of the Batignolles tunnel and the construction of low-level platforms under the present terminus for the suburban trains. The pulling down of the tunnel has already been started upon, and is likely to cause serious inconvenience through the necessity of stopping trains from the populous residential district of Auteuil at the Rue Cardinet instead of coming practically into the centre of the city. It will obviously be a considerable time before the works are completed, and meanwhile the suburban traffic will be more or less disorganised. It is now suggested that this trouble can be avoided by joining up the Auteuil line with the Nord-Sud. The solution is simple, and it would render unnecessary the costly transformation of the Gare St. Lazare. There are, however, interests to be considered which may lead the State railways to reject the proposal.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

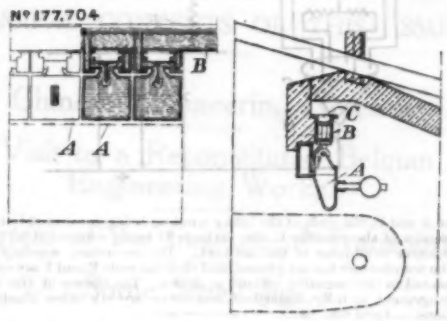
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

177,704. March 24th, 1921.—TRAVELLING GRATES, *Babcock and Wilcox, Limited, Oriel House, 30, Farringdon-street, London, E.C. 4.*

In order to prevent the ingress of air at the back of chain-grate stokers the pockets A A are mounted pivotally on the hollow bar B. Water circulates through the pockets as shown

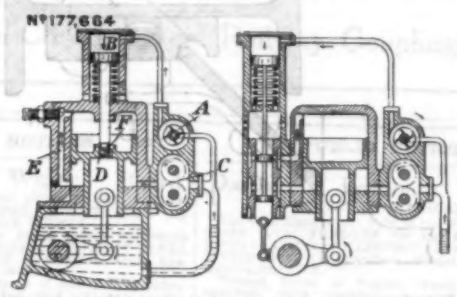


by the arrows, for the purpose of keeping them cool, and escapes along the trough C formed on the top of the hollow bar.—*April 6th, 1922.*

TURBINE MACHINERY.

177,664. February 15th, 1921.—HYDRAULIC TURBINE GOVERNORS, J. Orten Böving, 46, Kingsway, London, W.C. 2.

In this governor a centrifugal impeller A, driven off the main turbine shaft, supplies oil to a piston B and its pressure is opposed by a spring. A pump C delivers oil to the lower side of the differential piston D, which is connected with the guide vanes of the turbine. A passage E makes communication between

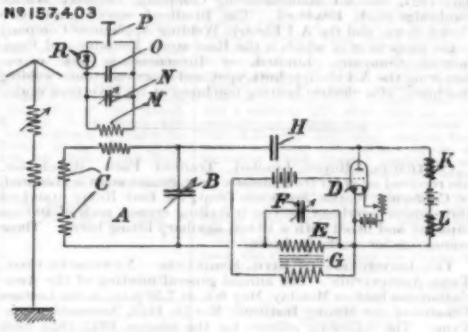


the two sides of the piston D, while an outlet from the top side is provided by the opening F. This opening is closed by a valve on the rod of the piston B. At normal speed sufficient oil escapes by F to keep the differential piston in equilibrium, but if the speed rises the pressure from A increases, B descends, and the opening F closes. Pressure then accumulates above D, which descends and controls the turbine. With a decrease in speed the movements are reversed.—*April 6th, 1922.*

WIRELESS TELEGRAPHY.

157,403. January 10th, 1921.—IMPROVEMENTS IN WIRELESS TELEGRAPH RECEIVERS, The Gesellschaft für Drahtlose Telegraphie m.b.H., of 9, Tempelhofer ufer, Berlin.

This invention relates to a receiving arrangement for undamped waves associated with wireless telegraphy, and is said to enable very audible and easily adjustable tones to be obtained. The antenna is coupled with a high-frequency circuit A which is composed of a variable condenser B and inductances C. Undamped oscillations are set up in the circuit A by the oscilla-

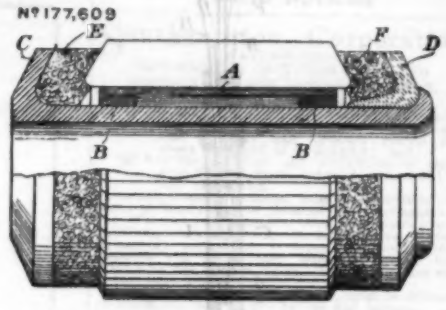


tions received on the antenna. The circuit A is also connected to a valve D for detecting the oscillations received. The frequency of the oscillations is tuned by a low-frequency circuit, which consists of a variable condenser F and one of the windings of the low-frequency transformer G, which is connected in the manner shown. H is a blocking condenser. K and L are choke coils, which are connected in series with a battery. A coil M coupled with the upper coil C of the circuit A forms with the variable condenser N the detector circuit, which is in parallel with a blocking condenser O and in series with a telephone P. The detector R may be any electrolytic or crystal detector or a thermionic valve, but in the latter case the connections of the detector circuit are altered in the well-known manner.—*April 6th, 1922.*

DYNAMOS AND MOTORS.

177,609. May 31st, 1920.—IMPROVEMENTS IN AND RELATING TO CURRENT COLLECTING DEVICES FOR DYNAMO-ELECTRIC MACHINES, *The British Thomson-Houston Company, 83 Cannon-street, E.C.*

With commutators constructed in accordance with this invention it has been possible to work with higher voltages and speeds than were previously permissible. The ring of commutator segments is mounted on an insulating tube A, supported by insulating rings B. The tube and rings may be made of layers of

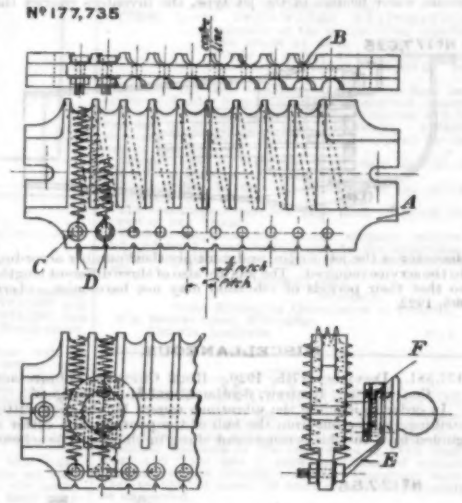


paper rolled and stuck together with shellac or Bakelite. End members C and D clamp the ring of commutator segments and resilient insulating rings E and F, which may be composed of spinable textile fibres. The method of making these rings and the general method of building the commutator are described.—*March 31st, 1922.*

SWITCHGEAR.

177,735. June 2nd, 1921.—IMPROVEMENTS IN AND RELATING TO ELECTRICAL RESISTANCE UNITS, Walter Reginald Mickelwright, of 10, Westbury-avenue, Wembley, Middlesex, and Mickelwright, Limited, of Perceval-lane, Alperton, Wembley.

Resistance coils are placed on a base A with grooves B. Holes are provided to take contacts C, to which the resistance wire is

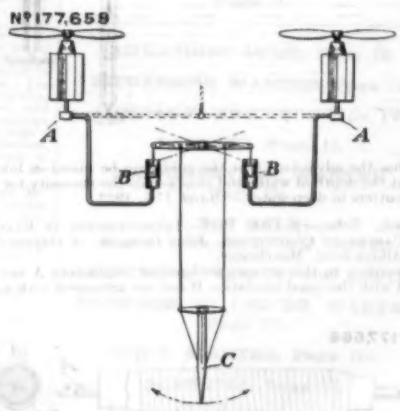


attached, the wire passing from groove to groove by way of the slots D. A sliding bush E and a contact bar F are provided for varying the amount of resistance in the circuit.—*April 6th, 1922.*

AERONAUTICS.

177,659. February 10th, 1921.—RUDDER CONTROL FOR TWIN-ENGINED AEROPLANES, Armstrong-Siddeley Motors, Limited, and F. M. Green, Parkside, Coventry.

In the event of the engines of a twin-screw aeroplane not running at the same speed, the device described in this specification puts over the rudder so as to maintain a straight course.

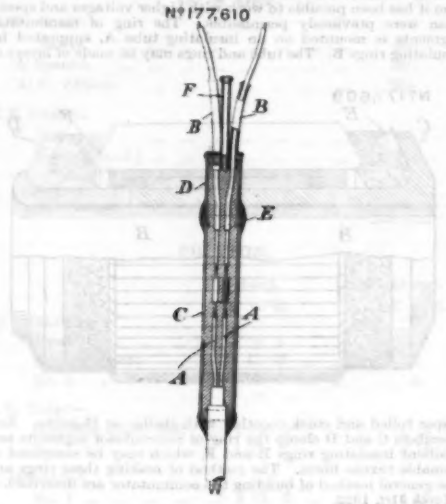


Pumps A A are geared to the engine crank shafts and the pressure they generate, which is proportional to the speed of the engines, is transmitted to the rams B B that operate the rudder C as shown.—*April 6th, 1922.*

TRANSMISSION OF POWER.

177,610. December 31st, 1920.—IMPROVEMENTS IN ELECTRICITY MULTI-CORE CABLE DIVIDING BOXES OR APPARATUS, The South Wales Electric Power Distribution Company, of Royal Chambers, Queen-street, Cardiff, and Arthur Wisdom, of Tonteg, Llantwit Vardre, near Pontypridd.

The cable cores are separated in the box in the manner shown and are led out through tubes B. Insulated sealing ends are provided at the outer extremities. An extra tube F is provided for

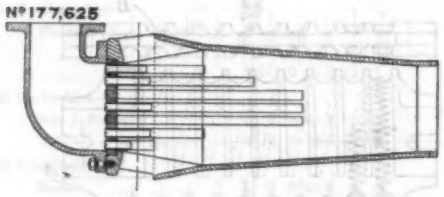


inserting insulating compound into the box. The box in which the tables are enclosed is composed of two metal parts C and D and are soldered together at E. The box is secured to a pole or other upright object by bolts and nuts.—*March 31st*, 1922.

LIGHTING AND HEATING.

177,625. January 11th, 1921.—STEAM JET WATER HEATERS, G. and J. Weir, Limited, Cathcart, Glasgow, and J. G. Weir.

In order to minimise the vibrations usually caused by exhaust steam water heaters of the jet type, the inventors restrict the

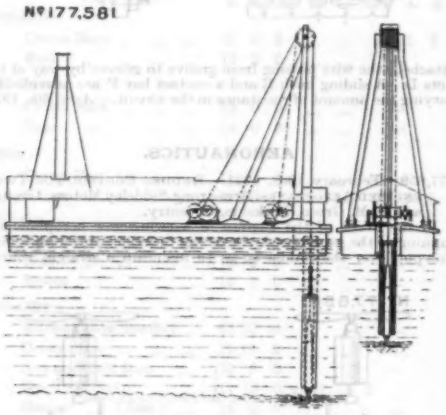


diameter of the jets to ¼in. and multiply their number according to the service required. The jets are also of three different lengths so that their periods of vibration may not harmonise.—*April 6th*, 1922.

MISCELLANEOUS.

177,581. December 17th, 1920.—ROCK CUTTERS, Lobnitz and Co., Limited, Renfrew, Scotland, and H. O. Bedgood.

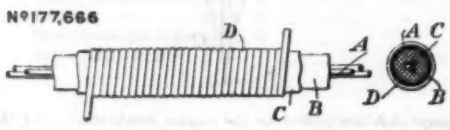
In order to insulate the vibrations caused by the rock cutter striking the bottom from the hull of the pontoon, the cutter is guided by a tubular arrangement slung in chains. The scheme



also has the advantage that the guide can be raised or lowered to suit the depth of water and thus avoids the necessity for very long cutters in deep water.—*March 17th*, 1922.

177,666. February 17th, 1921.—IMPROVEMENTS IN ELECTRIC CABLES OR CONDUCTORS, John Drennan, of Gayton Mill, Albion-road, Manchester.

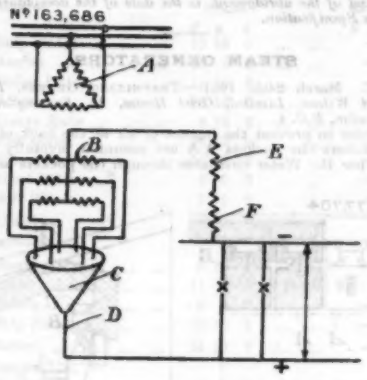
According to this invention electrical conductors A are provided with the usual insulation B and are armoured with a strip



of lead C or other relatively soft and pliable metal, which is folded longitudinally around the conductors in one or more layers, with a considerable overlap at the edges. Coils of aluminium or other pliable non-rusting wire D serve to bind the lead strip firmly upon the conductors.—*April 6th*, 1922.

163,686. May 15th, 1920.—IMPROVEMENTS IN APPARATUS FOR SUPPRESSING THE UPPER HARMONIC WAVES IN THE DIRECT-CURRENT CIRCUIT OF METAL VAPOUR RECTIFIERS, Brown, Boveri and Cie., of Baden, Switzerland.

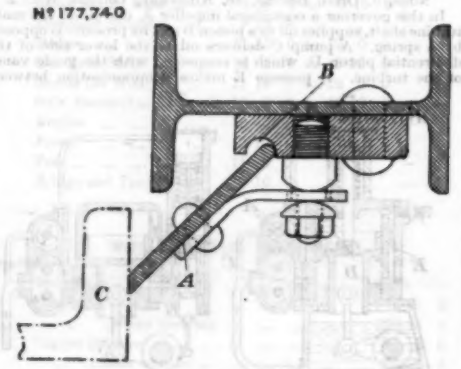
A direct current taken from an alternating-current network through a metal vapour rectifier has large upper harmonic waves, which in many cases have a disturbing influence, and the object of this invention is to eliminate this trouble. In the diagram the primary and secondary windings of the transformer are shown



at A and B, the ends of the latter winding being connected to the anodes of the rectifier C, the cathode D being connected to the positive conductor of the network. The secondary winding of the transformer has six phases, and choking coils E and F are connected in the negative circuit as shown. The theory of the arrangement is fully described and there are six other illustrations.—*April 6th*, 1922.

177,740. June 21st, 1921.—SLUICE GATES, J. Ashford, Amritsar, Punjab, India.

This invention has for its object a simple and effective staunching device for sluice gates and the like. It comprises essentially a narrow plate A of such thickness as to have a certain amount of flexibility, and which is flexibly supported from the gate in such wise that while its one edge pivots in a groove B near the side of the gate, its other edge lying at an angle in the vertical



plane of the gate, makes joint with the face of the jamb C of the sluice way. It will be seen that the staunching plate thus lying on the upstream face of the gate and at an angle (which to be most effective should be of the order of 45 deg.) between gate and jamb, is forced by the upstream head of water into close contact with these parts, the slight flexibility of the plate allowing it to accommodate itself to any slight irregularity of alignment between the parts.—*April 6th*, 1922.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WE are informed that the Lassen Meter and Engineering Company has been acquired by James Gordon and Co., Limited, of Windsor House, Kingsway, W.C. 2. Mr. J. J. Lassen has accepted the position of joint managing director, and will personally conduct the section of the business dealing with boiler efficiency appliances and instruments.

THE A-I ELECTRIC WELDING APPLIANCES COMPANY, of 183, Westminster Bridge-road, London, S.E. 1, informs us that it has purchased from the proprietors, Mr. James and Mr. Dudley Forman, of Messrs. Thos. Forman and Sons, as from December 1st, 1921, the A-I Manufacturing Company, Industry Works, Sunbridge-road, Bradford. The Bradford works have been closed down, and the A-I Electric Welding Appliances Company—the proprietor of which is the Rose-street Foundry and Engineering Company, Limited, of Inverness—is now manufacturing the A-I electric butt, spot and seam resistance welding machines, also electric heating machines at its Inverness works.

CONTRACTS.—Royce Limited, Trafford Park, Manchester, has received an order from Messrs. Kerr, Stuart and Co., Limited, of California Works, Stoke-on-Trent, for four Royce standard three-motor overhead electric travelling cranes, each of 40 tons capacity and fitted with a 10-ton auxiliary lifting barrel. These cranes are for works in India.

THE INSTITUTION OF CIVIL ENGINEERS: NEWCASTLE-UPON-TYNE ASSOCIATION.—The annual general meeting of the Association was held on Monday, May 8th, at 7.30 p.m., in the Lecture Theatre of the Mining Institute, Neville Hall, Newcastle-upon-Tyne. The following officers for the session 1922–1923 were elected:—President: Mr. R. F. Hindmarsh, M. Inst. C.E. Vice-presidents: Messrs. D. Balfour, M. Inst. C.E., G. F. Palmer, M. Inst. C.E., J. R. Baterden, Assoc. M. Inst. C.E., and W. H. Dickenson, B.Sc., Assoc. M. Inst. C.E. Council: Corporate Members—Messrs. F. E. Harrison, M. Inst. C.E., Professor H. Louis, M.A., M. Inst. C.E., W. Sewell, M. Inst. C.E., W. J. Steel, D.S.O., M. Inst. C.E., Professor C. J. Hawkes, Assoc. M. Inst. C.E., and J. E. Parker, Assoc. M. Inst. C.E.; Student Members—Messrs. E. L. Everatt, W. C. Knill, H. D. Harrison, and E. J. Rang. After the business of the meeting there was a discussion on "Reinforced Concrete," introduced by Mr. C. H. Sandeman, M. Inst. C.E.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

JUNIOR INSTITUTION OF ENGINEERS.—Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Lecture, "Tanks and Chain Track Artillery," by Mr. L. A. Legros. 7.30 p.m.

WEST BROMWICH ENGINEERING SOCIETY.—Technical School, West Bromwich. Paper, "Fuels," by Mr. S. Lamb. 7.30 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Holborn Borough Council Offices (opposite British Museum Tube Station). Metropolitan District meeting to consider the question of the revision of the areas allotted to the different Districts of the Institution. 4 p.m.

PHYSICAL SOCIETY OF LONDON.—Imperial College of Science, South Kensington, S.W. (1) Demonstration of some electrical properties of neon-filled lamps, by Mr. S. O. Pearson, B.Sc., and Mr. H. St. G. Anson; (2) "A New Apparatus for the Measurement of the Polarisation Capacity of Platinum Plates in Sulphuric Acid," by Mr. A. Griffiths, D.Sc., and Mr. W. T. Heys, B.Sc.; (3) "The Molecular Forces Involved in Cohesion," by Mr. Herbert Chatley, D.Sc. 5 p.m.

SATURDAY, MAY 13TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. Lecture, "The Disappearing Gap between the X-ray and Ultra-violet Spectra," by Mr. C. W. Richardson, D.Sc. 3 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South-Eastern District meeting to be held at Tonbridge. 11.15 a.m.

WEDNESDAY, MAY 17TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—Y.M.C.A. Hall, Albion-place, Albion-street, Leeds. Paper: "Experiments on Cams and Poppet Valves," by Professor G. F. Scholes. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Chamber of Commerce, New-street, Birmingham. Meeting of Birmingham Graduates. Paper, "Progress," by Mr. A. O. Marshall. 7.30 p.m.

INSTITUTION OF RAILWAY SIGNAL ENGINEERS.—Institution of Electrical Engineers, Victoria Embankment. Resumed discussion on paper, "Some Recent Developments of Token Working on Single-line Railways," by Mr. W. S. Roberts. 3 p.m.

ROYAL METEOROLOGICAL SOCIETY.—49, Cromwell-road, South Kensington, S.W. 7. Papers:—(1) "Weather and the Crop Yield in the North-East Counties of Scotland," by Mr. A. E. M. Geddes; (2) "A New Form of Direct Reading Barometer," by Mr. H. P. Waran. 5 p.m.

WEDNESDAY TO SATURDAY, MAY 17TH TO 20TH.

THE INSTITUTE OF TRANSPORT.—Congress. For programme see page 468.

THURSDAY, MAY 18TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—28, Victoria-street, S.W. 1. Meeting of the London Graduates. Paper, "Electrical Equipment," by Messrs. P. H. Hardy and L. B. Harris. 8 p.m.

THE JUNIOR INSTITUTION OF ENGINEERS.—Monico Restaurant. Annual dinner to celebrate the thirty-eighth anniversary of Institution's foundation. 6.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C. 2. Thirteenth Kelvin Lecture, "Electricity and Matter," by Sir Ernest Rutherford. 6 p.m.

FRIDAY, MAY 19TH.

JUNIOR INSTITUTION OF ENGINEERS.—Caxton Hall, Westminster, S.W. 1. Lecturette, "Engineering Business in China," by Mr. F. W. G. Clark. 8 p.m.

SATURDAY, MAY 27TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Whole-day visit of the London Graduates to the works of Cubitt's Engineering Company, Limited, Aylesbury.

TUESDAY, MAY 30TH, TO FRIDAY, JUNE 2ND.

INSTITUTION OF ELECTRICAL ENGINEERS.—Summer Meeting in Scotland. Ladies invited. For programme, see page 326.

WEDNESDAY, MAY 31ST.

ROYAL AERONAUTICAL SOCIETY.—Visit to the Royal Aircraft Establishment, South Farnborough. Meet at Booking Office, Waterloo Station. 8.40 a.m.

FRIDAY, JUNE 2ND.

DIESEL ENGINE USERS' ASSOCIATION.—Institution of Electrical Engineers, Victoria Embankment. Paper, "Marine Diesel Engines," by Mr. H. F. P. Purday, B.Sc. Non-members desirous of attending the meeting can make application for tickets of admission to the hon. secretary at 19, Cadogan-gardens, S.W. 3.

SATURDAY, JUNE 3RD.

ROYAL AERONAUTICAL SOCIETY.—Visit to the National Physical Laboratory, Teddington. Meet at the booking-office, Waterloo (L. and S.W.). 9.15 a.m.

MONDAY AND TUESDAY, JUNE 5TH AND 6TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Meeting of the South African District, to be held at Bloemfontein.

MONDAY TO WEDNESDAY, JUNE 19TH TO 21ST.

INSTITUTE OF COST AND WORKS ACCOUNTANTS.—Sessional examinations will be held in London, Manchester, Birmingham, Sheffield, Glasgow and Bristol.

A CATALOGUE IN SPANISH.—A special edition of the catalogue of the Associated British Machine Tool Makers has just been issued in the Spanish language. It deals very fully with all the machines made by the firms belonging to the Association, and the particulars are given in metric measures. The catalogue occupies over 700 well-printed pages, and includes a special code for ordering machines by cablegram.

ROYAL INSTITUTION.—A general meeting of the members of the Royal Institution was held on the afternoon of May 8th, Sir James Reid, Bart., Vice-president, in the chair. The deaths of Sir Alfred Kempe and Sir William Phipson Beale, late Vice-presidents and Managers, were announced, and resolutions of condolence with the families were passed. Mr. J. P. Blessig, Dr. W. D. Halliburton, Dr. E. H. Hankin, Mrs. Percy MacQuoid, Mr. S. T. Nunn, and Mrs. Theodore Stephenson were elected members.